

## Predictors of health awareness regarding the consumption of tuak amongst the people of longhouses in Malaysia

<sup>1</sup>Marcus, A., <sup>1</sup>Latif, N., <sup>1,2</sup>Paul, B.T., <sup>1</sup>Mustafa, S., <sup>1</sup>Hanafiah, M.H.M.A., <sup>1</sup>Malahubban, M., <sup>1</sup>Abit, L.Y., <sup>3</sup>Wan, K.L., <sup>4</sup>Hussain, S.S.S. and <sup>1,5,\*</sup>Kamaludeen, J.

<sup>1</sup>Department of Animal Science and Fishery, Faculty of Agricultural and Forestry Sciences, Universiti Putra Malaysia Bintulu Sarawak Campus, Bintulu 97008, Sarawak, Malaysia

<sup>2</sup>Veterinary Teaching Hospital, Faculty of Veterinary Medicine, University of Maiduguri, 600230 Bama Road, Maiduguri, Borno, Nigeria

<sup>3</sup>Department of Biological Sciences and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Bangi, Malaysia

<sup>4</sup>Department of Veterinary Clinical Studies, Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia

<sup>5</sup>Institute of Tropical Agriculture and Food Security, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

### Article history:

Received: 1 March 2024

Received in revised form: 18 April 2024

Accepted: 20 August 2024

Available Online: 9

December 2025

### Keywords:

Malaysian Borneo, Sarawak, Health awareness, Knowledge, Predictors, Tuak

### DOI:

[https://doi.org/10.26656/fr.2017.9\(6\).053](https://doi.org/10.26656/fr.2017.9(6).053)

### Abstract

Tuak is the ubiquitous alcoholic beverage associated with the natives of Sarawak. The present study determined the level of knowledge regarding the practices of the traditional alcoholic beverage in Sarawak known as tuak, as well as the production and consumption of it among indigenous people from selected longhouses. A cross-sectional questionnaire survey was conducted between January and June 2022 to collect relevant information, including demographic characteristics and responses to structured questions (in English and included with a Malay translation) on knowledge regarding the health effects of tuak consumption. A total of 90 respondents comprising mainly females ( $n = 62$ ; 68.9%), aged below 30 years ( $n = 46$ ; 51.1%), and primarily comprising people of Kayan ( $n = 42$ ; 46.7%) ethnicity participated. The results of univariable logistic regression showed that participants' age group, localities, education, and marital status were associated with good knowledge of the health effects of tuak. Multivariable logistic regression analysis further showed that those aged above 50 years were more knowledgeable than those 30-50 years old (adjusted odds ratio (AOR) = 6.06, 95% CI: 1.01-36.47,  $P = 0.049$ ). The respondents from Bare (AOR = 10.26, 95% CI: 1.91-55.05,  $P = 0.007$ ) and Belor (AOR = 24.13, 95% CI: 3.90-149.41,  $P = 0.001$ ) were also more knowledgeable than those from Kelap. Furthermore, respondents with a tertiary education were more knowledgeable than those with a secondary education (AOR = 13.07, 95 %CI: 3.12-54.72,  $p \leq 0.001$ ). Those with household incomes below Ringgit Malaysia (RM) 2500 were more knowledgeable than those with household incomes above RM2500 (AOR = 4.99, 95% CI: 1.09-22.89,  $p = 0.039$ ). The age, locality, education level and household income of the respondents were the main predictors of good knowledge of health awareness of tuak consumption among the indigenous people of Borneo, Sarawak.

## 1. Introduction

Traditional food is recognised as a vital component in culture and history, as one of the media representing the individuality of cuisine (Md. Nor *et al.*, 2012). The wide variations in the cuisines of various ethnic groups in Borneo, Sarawak provide distinctiveness in savouring the authentic or actual flavour of ethnic inhabitants' traditional or original meals. For instance, the Iban are

known for their tubu (stems), tuak (an alcoholic beverage made from rice wine), and pansuh (meat cooked with bamboo), while the Melanau have their tebaloi (Sago palm crackers) and sagu (extracted from Sago palm). The Orang Ulu, which is a term representing approximately 27 tribal groups such as the Kelabits and Lunbawangs, are known for their garam bario (Highland's salt), kikid (broth), tengayen (local young

\*Corresponding author.

Email: [juriahk@upm.edu.my](mailto:juriahk@upm.edu.my)

leaves), and urum giruq (pudding), while the Malays are known for their kek lapis Sarawak (also known as the layered cake of Sarawak) (Salehuddin *et al.*, 2011). Melanau people are also known for their umai (raw fish mixed with lime juice) (Sukirman *et al.*, 2020). Understanding of culture, communication, and personality can be gleaned from different ethnic cuisines (Carolan, 2018).

Despite this, the traditional cuisine of the many ethnic groups in Sarawak is still poorly understood. A common misconception among nonnatives about tuak, an alcoholic beverage, is that it is simply another intoxicating drink. However, there is much more to this beverage in terms of culture, symbolism, and heritage, making it a significant part of most non-Muslim tribes in Sarawak, spanning the gamut from Iban, Bidayuh, Orang Ulu, Bisaya, and other native communities. Tuak is a distinctive traditional drink among Sarawakians. The Tuak drinking culture is embedded in native society to the point of becoming part of the daily routine. Tuak is an alcoholic beverage that is used on many occasions (Firmando, 2020). Tuak can be described as having a translucent pale golden colour, with a sweet fruity aroma and a slightly sweet, sour and tangy taste similar to the Korean makgeolli, which is a cloudy whitish to yellowish opaque liquid with a sweet fruity aroma and slightly bitter, alcoholic, and sour taste (Sinaga and Salim, 2019; Shimoga and Kim, 2022; Wong *et al.*, 2023). This fermented glutinous rice drink is a common table drink and part of every aspect of life, including happiness, sorrow and work, and has been strongly associated with religious-ritualisation as a gift, medical aid, wedding ceremonies and as a ritual offering, especially during the yearly harvest festival (Gawai) (Bunyau, 2017; Mohd Nor *et al.*, 2020).

In modern times, native communities are more likely to make tuak according to the season, and only a small number produce tuak outside of the festival season. Various factors affect this change, such as changes in the living environment, societal views towards tuak, religion and economic activities of the Iban community (Firmando, 2020). For instance, the changing living environment plays a significant role in influencing tuak production, and the advent of formal education significantly contributes to the change in people's perceptions of tuak. Nevertheless, there is increasing consumption of tuak even in this modern era. Thus, the focus of this article is to describe the awareness regarding the health effects of tuak among consumers. The present study assessed the level of knowledge and health awareness regarding the practices of tuak production and consumption among the indigenous communities of Sarawak.

## 2. Materials and methods

### 2.1 Ethics approval and consent to participate

Informed consent has been obtained from all individuals included in this study.

### 2.2 Study approach

The information used in the present research was obtained from a multitude of helpful sources and concentrated on the key elements required to create the research instrument (questionnaire). The methods used to compile the data were thorough to guarantee data accuracy. In Bintulu, Sarawak (3.1739°N, 113.0428°E), four (4) chosen individuals who were predominantly involved in tuak production were interviewed face to face and over the phone. These individuals were chosen to garner the necessary data for this study, which was then used as the main source of information. They were interviewed informally to learn more about tuak production and their knowledge of the product, and these answers were refined and used to create the research questionnaire. The questionnaire was trialled on several individuals randomly before the actual field survey. This was done to ensure that the questions were clear and concise while meeting the research requirements.

### 2.3 Research instruments

The main research instrument used in the survey was a questionnaire. The questionnaire utilised in this study was designed to include both closed-ended and open-ended questions. The questionnaire was divided into six sections based on the following: (i) respondents' demographic data, (ii) purpose for tuak production, (iii) list of ingredients and materials for tuak production, (iv) process of tuak production (Bunyau, 2017; Shimoga and Kim, 2022), (v) knowledge of tuak production, and (vi) health awareness among drinkers. In Northern Borneo Sarawak, the questionnaire was distributed to a total of 90 households. Google Forms was used to construct an online survey, which was then printed as hard copies. Appointments were scheduled through a representative at each longhouse via telephone before the distribution of questionnaires. Throughout the distribution and data collection, one survey assistant was appointed to conduct the data collection to ease the survey study. The interviewer's responsibility was to make it easier for respondents to reply to questions by giving them enough information throughout the interview. The survey was carried out from January to June 2022. Data were tabulated in Microsoft Excel Version 2010.

### 2.4 Study design, study area and sample site selection

The present study presents a cross-sectional study in Northern Sarawak, Malaysia, carried out with the

participation of a few longhouses within this area. The study sites were selected based on ease of access to tuak-producing households located within the study region. A total of 4 longhouses were sampled, comprising a total of 90 households. The sampling locations with geo-satellite locations were as follows: Rumah Ningkan (3.1005782, 112.9216239), Rumah Panjang Bare (3.1404016, 113.2769404), Uma Belor (3.033191, 113.919420), and Uma Kelap (3.062595, 113.936447).

2.5 Statistical analysis

Data collected from the completed questionnaires were manually input into a Microsoft Excel Version 2010 spreadsheet. The demographic characteristics of the respondents who participated as independent variables were subsequently categorised. The number of responses and frequency distribution, as well as the frequency and percentage of respondents who chose each given response (strongly disagree-disagree, somewhat agree, and agree-strongly agree), were tabulated on a Likert scale as descriptive statistics. A summary was made from the Likert-scale responses for the section on respondents' health awareness based on their agreement. Correct responses received a score of "one," while incorrect responses received a score of "zero" for the section intended to evaluate respondents' knowledge. As a result, each respondent's total knowledge score varied from 0 to 10. For logistic regression, the knowledge score was categorised as poor (0 to 4) or good (5 to 10). A univariable binary logistic regression analysis was designed to analyse the association between the knowledge score and demographic characteristics of the respondents. The factors were considered significant at  $p \leq 0.05$ . The significant variables from univariable analysis were included in the multivariable analysis to identify the predictors of good knowledge among tuak consumers. Multivariable binary logistic regression using a backwards conditional variable selection with entry at 0.05 and removal at 0.10 was used to filter for the predictors of good knowledge among the respondents. The significant variables from the multivariable analysis were recognised as predictors of health awareness, and the results are presented as adjusted odds ratio (AOR) and 95% confidence interval (CI).

3. Results

3.1 Characteristics of respondents

The distribution of respondents according to their demographic characteristics is presented in Table 1. Out of a total of 90 respondents, most were females, and the age groups were 51.1%, 34.4%, and 14% below 30 years old, 30-50 years, and above 50 years, respectively. Approximately 46.7% were Kayan, and other

respondents belonged to other races. For locality, the highest respondents were Uma Kelap, followed by Rumah Panjang Bare and Rumah Ningkan. Most of the respondents possessed a secondary level of education (56.7%), and others had a primary or higher education level. Labourers made up the largest group of respondents, followed by students, self-employed individuals, and unemployed individuals. For household income, 81.1% of them had an average income of Ringgit Malaysia (RM) 2500, while the remaining 18.9% were above RM2500.

Table 1. Demographic characteristics of the respondents of selected longhouses (n = 90).

Variable	Frequency	Percentage
<b>Gender</b>		
Male	28	31.1
Female	62	68.9
<b>Age</b>		
<30 years	46	51.1
30 - 50 years	31	34.4
> 50 years	13	14.4
<b>Race</b>		
Iban	35	38.9
Kayan	42	46.7
Others	13	14.4
<b>Marital status</b>		
Single	41	45.6
Married	49	54.4
<b>Locality</b>		
Bare	20	22.2
Ningkan	18	20.0
Belor	18	20.0
Kelap	34	37.8
<b>Level of education</b>		
Primary	12	13.3
Secondary	51	56.7
Higher	27	30.0
<b>Occupation</b>		
Student	22	24.4
Labourer	31	34.4
Self employed	19	21.1
Unemployed	18	20.0
<b>Household income (MYR)</b>		
Below 2500	73	81.1
Above 2500	17	18.9
Total	90	100.0

3.2 Health knowledge of Borneo rice wine consumption in selected longhouses in Sarawak

The responses regarding health awareness towards Borneo rice wine (tuak) consumption in selected

longhouses in Sarawak are shown in Table 2. Although a higher proportion of respondents agreed that excess consumption of tuak causes nausea and loss of control (96.6%), some of the respondents disagreed (3.3%). Most of the respondents also agreed that the long-term consumption of tuak may cause liver disease (52.1%). A total of 57.7% of the respondents agreed that long-term tuak consumption may cause obesity. Furthermore, the long-term consumption of tuak can cause obesity, and 56.6% of the respondents agreed, while 43.4% disagreed. Approximately 54.5% of the respondents agreed that long-term consumption can cause stomach ulcers, whereas 33.3% of the respondents agreed that long-term consumption can cause cancer. A total of 66.7% of them disagreed that long-term consumption could cause cancer. Additionally, 72.2% of the respondents agreed that excess consumption can cause dehydration and damage the nervous system (44.4%) and that long-term consumption of tuak can cause intestinal damage (51.1%). However, 65.6% of the respondents disagreed that long-term consumption of tuak can cause tuberculosis.

The results of univariable analysis showing the odds ratio (OR) and 95% CI for the association between good knowledge score and demographic characteristics of the respondents from selected longhouses in Sarawak are shown in Table 3. There was a significant association between the good knowledge score and age groups above 50 (OR = 4.09, 95% CI: 1.02-16.40,  $p = 0.047$ ) and below 30 (OR = 3.41, 95% CI: 1.31-8.85,  $p = 0.012$ ); localities in Bare (OR = 3.41, 95% CI: 1.07 - 10.83,  $p = 0.038$ ) and Belor (OR = 14.67, 95% CI: 2.88-74.83,  $p \leq 0.001$ ); tertiary education (OR = 3.48; 95% CI: 1.25-9.67,  $p = 0.017$ ); student category (OR = 5.34, 95% CI: 1.35-21.14,  $p = 0.017$ ); and single marital status (OR = 3.22, 95% CI: 1.34-7.76,  $p = 0.009$ ). However, there was

no significant association between the good knowledge score of the respondents and male category (OR = 1.69, 95% CI: 0.67-4.23,  $p = 0.265$ ), Iban people (OR = 1.97, 95% CI: 0.55-7.16,  $p = 0.301$ ) and Kayan (OR = 1.28, 95% CI: 0.37-4.47,  $p = 0.695$ ), locality in Ningkan (OR = 1.83, 95% CI: 0.57-5.86,  $p = 0.306$ ), primary education (OR = 1.70, 95% CI: 0.48-6.09,  $p = 0.412$ ), labourer category (OR = 1.29, 95% CI: 0.40-4.22,  $p = 0.669$ ) and self-employed (OR = 2.69, 95% CI: 0.71-10.18,  $p = 0.144$ ), and household income (OR = 2.05, 95% CI: 0.70 -5.99,  $p = 0.190$ ).

The results of the multivariable logistic regression analysis showing the predictors of good knowledge among tuak consumers from selected longhouses in Sarawak are shown in Table 4. There was a significant association between the good knowledge score and the age, locality, and education of the respondents. Multivariable logistic regression analysis showed that participants above 50 years old (AOR = 6.06, 95% CI: 1.01 - 36.47,  $p = 0.049$ ) had a higher likelihood of good knowledge than those aged 30-50 years old. In terms of the locality, respondents from Bare (AOR = 10.26, 95% CI: 1.91-55.05,  $p = 0.007$ ) and Belor 24.13 (95% CI: 3.90-149.41,  $p \leq 0.001$ ) had higher likelihoods of good knowledge than those from Kelap. For education, respondents with a tertiary education (AOR = 13.07, 95% CI: 3.12-54.72,  $p \leq 0.001$ ) had a higher likelihood of good knowledge than those with a secondary level of education. The respondents with household incomes below RM2500 had a higher likelihood (AOR = 4.99, 95% CI: 1.09-22.89,  $p = 0.039$ ) of having good knowledge than those with incomes above RM2500.

#### 4. Discussion

This study is an attempt to assess the knowledge of Sarawakian natives regarding the public health

Table 2. Summary of responses to survey questionnaire on the health knowledge towards Borneo rice wine (tuak) consumption in selected longhouses in Sarawak.

Questions	No of respondents (%)					Total
	SD	D	SMA	A	SA	
Excess consumption of tuak causes nausea and loss of control	2 (2.2)	1 (1.1)	3 (3.3)	63 (70)	21 (23.3)	90 (100)
Long-term consumption causes liver damage	26 (28.9)	17 (18.9)	22 (24.4)	21 (23.3)	4 (4.4)	90 (100)
Long-term consumption causes diabetes	12 (13.3)	26 (28.9)	31 (34.4)	17 (18.9)	4 (4.4)	90 (100)
Long-term drinking causes obesity	15 (16.7)	24 (26.7)	30 (33.3)	17 (18.9)	4 (4.4)	90 (100)
Long-term consumption causes stomach ulcer	20 (22.2)	21 (23.3)	28 (31.1)	16 (17.8)	5 (5.6)	90 (100)
Long-term consumption causes to cancer	36 (40)	24 (26.7)	16 (17.8)	13 (14.4)	1 (1.1)	90 (100)
Excess consumption causes dehydration	11 (12.2)	14 (15.6)	43 (47.8)	20 (22.2)	2 (2.2)	90 (100)
Excess consumption damages body nervous system	28 (32.2)	21 (23.3)	21 (23.3)	17 (18.9)	2 (2.2)	90 (100)
Long-term consumption causes intestinal damage	14 (15.6)	30 (33.3)	26 (28.9)	16 (17.8)	4 (4.4)	90 (100)
Long-term consumption causes tuberculosis	36 (40)	23 (25.6)	18 (20.0)	11 (12.2)	2 (2.2)	90 (100)

SD = strongly disagree; D = disagree; SMA = somewhat agree; A = agree; SA = strongly agree

Table 3. Results of univariable analysis showing the odds ratios and 95% CIs for the association between good and poor knowledge scores and demographic characteristics of tuak consumers.

Variables	No.	GKS (%)	PKS (%)	$\chi^2$	OR	95% CI	P value
<b>Gender</b>							
Male	28	18 (36)	10 (25)	1.255	1.687	0.67 – 4.23	0.265
Female	62	32 (64)	30 (75)		1.000	Reference	
<b>Age</b>							
Below 30	46	30 (60)	16 (40)	7.782	3.409	1.31 – 8.85	0.012*
Above 50	13	9 (18)	4 (10)		4.091	1.02 – 16.40	0.047*
30 – 50	31	11 (22)	20 (50)		1.000	Reference	
<b>Race</b>							
Iban	35	22 (44)	13 (32.5)	1.393	1.974	0.55 – 7.16	0.301
Kayan	42	22 (44)	20 (50)		1.283	0.37 – 4.47	0.695
Others	13	6 (12)	7 (17.5)		1.000	Reference	
<b>Locality</b>							
Bare	20	13 (26)	7 (17.5)	14.700	3.405	1.07 – 10.83	0.038*
Ningkan	18	9 (18)	9 (22.5)		1.833	0.57 – 5.86	0.306
Belor	18	16 (32)	2 (5)		14.667	2.88 – 74.83	0.001*
Kelap	34	12 (24)	22 (55)		1.000	Reference	
<b>Education level</b>							
Tertiary	27	20 (40)	7 (17.5)	6.046	3.478	1.25 – 9.67	0.017*
Primary	12	7 (14)	5 (12.5)		1.704	0.48 – 6.09	0.412
Secondary	51	23 (46)	28 (70)		1.000	Reference	
<b>Occupation</b>							
Student	22	17 (34)	5 (12.5)	8.028	5.343	1.35 – 21.14	0.017*
Labourer	31	14 (28)	17 (42.5)		1.294	0.40 – 4.22	0.669
Self-employed	19	12 (24)	7 (17.5)		2.694	0.71 – 10.18	0.144
Unemployed	18	7 (14)	11 (27.5)		1.000	Reference	
<b>Marital Status</b>							
Single	41	29 (58)	12 (30)	7.024	3.222	1.34 – 7.76	0.009*
Married	49	21 (42)	28 (70)		1.000	Reference	
<b>Income</b>							
Below RM2500	73	43 (86)	30 (75)	1.755	2.048	0.70 – 5.99	0.19
Above RM2500	17	7 (14)	10 (25)		1.000	Reference	

GKS: good knowledge score, PKS: poor knowledge score,  $\chi^2$ : chi square, OR: odds ratio, CI: confidence intervals, \* denotes statistical significance.

Table 4. Results of multivariable logistic regression analysis showing the predictors of good knowledge among tuak respondents from selected longhouses in Sarawak.

Variables	B	S.E.	Wald	p value	AOR	95% C I	
						Lower	Upper
<b>Age</b>							
Below 30	1.01	0.68	2.19	0.14	2.75	0.72	10.45
Above 50	1.80	0.92	3.87	0.049*	6.06	1.01	36.47
<b>Locality</b>							
Bare	2.33	0.86	7.38	0.007*	10.26	1.91	55.05
Ningkan	1.05	0.74	2.04	0.15	2.85	0.68	12.05
Belor	3.18	0.93	11.71	0.001*	24.13	3.90	149.41
<b>Education</b>							
Tertiary	2.57	0.73	12.38	<0.001*	13.07	3.12	54.72
Primary	0.17	0.98	0.03	0.87	1.18	0.17	8.06
<b>Income</b>							
Below 2500	1.61	0.78	4.28	0.039*	4.99	1.09	22.89
Constant	-3.86	1.05	13.41	0.00	0.02		

B: regression coefficient, S.E.: standard error, Wald: chi square, AOR: adjusted odds ratio, CI: confidence intervals. \* denotes statistical significance.

importance of tuak consumption. Tuak is a unique handmade rice wine brewed by the indigenous people of Sarawak. It is currently recognised as cultural heritage. As documented from the survey findings, the respondents used glutinous rice, ragi (a fermenting agent or starter culture) and sugar to produce tuak, which is quite similar to other Asian cloudy rice wines, such as Korean makgeolli (Shimoga and Kim, 2022). The glutinous rice was washed and cooked before being left to cool down and then mixed well with ragi. The process is similar to that of makgeolli, which also utilises glutinous rice and nuruk as the starter culture (Nile, 2015; Wong *et al.*, 2023). Traditionally, tuak is left to ferment in a tajau (a covered clay vase). However, modern production often utilises plastic containers as a replacement for the tajau.

In the present study, most of the respondents were females, and it was determined that mainly married women were responsible for making tuak (Table 1). Tuak production is often led by those aged 30 years and above, as they have more skills and experience in making tuak. Most of the survey respondents had an income below RM2500. Thus, tuak drinking is not particularly related to any social status, as this drink is cheap to make (Sinaga and Salim, 2019). Many of the native group of Sarawak enjoy making and consuming tuak, and it is widely seen as an integral part of their culture and heritage (Langgat *et al.*, 2011). Even though it is mainly prepared during festivals and ceremonies, tuak is readily available year-round, as its alcoholic nature allows it to be stored almost indefinitely. Tuak was once a highly valued commodity that may have introduced a multi-stimulus of the environment to encourage exploration, curiosity, and entertainment (Kim *et al.*, 2010; Organ *et al.*, 2015). Gender, age differences, level of education and ethnicity are well documented in the sociological literature on this subject, yet no previous studies have estimated these differences that are directly associated with tuak use. Thus, the present study presents a unique perspective on this subject.

In Table 2, most of the respondents agree that excess consumption of tuak causes nausea and loss of control, as well as that the long-term consumption of tuak causes liver damage. Since the liver is the primary mechanism of ethanol metabolism, heavy drinking causes the most tissue destruction within it. Steatosis, hepatitis, and fibrosis/cirrhosis are the most recognisable liver lesions that are caused by chronic and heavy alcohol use (Osna *et al.*, 2017). Alcohol-related hepatitis, which is known to be a precursor to liver cirrhosis, will develop in a significantly lower proportion of heavy drinkers. The prognosis for severe alcohol-associated liver damage is extremely dismal. A study has shown that at five years,

the mortality rate for patients with cirrhosis-related alcohol-associated hepatitis is greater than 65% (Subramaniyan *et al.*, 2021). Alcohol consumption causes several physiological, metabolic, and neuroimmunology consequences that collectively add up to the hangover sensation. The strongest predictors of the total severity of a hangover were nausea, exhaustion, thirst, and tension (Penning *et al.*, 2012). Alcohol-related deaths rose from 2019 to 2020 for both males and females aged 65 and over and 75 and older (Kramarow and Tejada-Vera, 2022). Although liver disease is increasingly recognised as a complex disease process, alcohol intake is a contributing factor (Roerecke *et al.*, 2019). Respondents acknowledge that long-term consumption can cause diabetes. All alcoholic beverages have sugar content. Glucose levels of wine from glutinous rice ranged between 300-440 mg/mL, twice that in common rice wine (Palaniveloo and Vairappan, 2013). There is a curvilinear association between the average amount of alcohol consumed and the onset of diabetes, which means that a low alcohol intake rate is protective, but higher consumption is related to an increased risk rate (Baliunas *et al.*, 2009). The findings of this study suggest that further investigation into the problem of hazardous alcohol use on drinking norms, as well as positive drinking consequences, is necessary to better promote community health in Sarawak.

Respondents also agreed that long-term high consumption of tuak causes obesity, stomach ulcers, dehydration, and intestinal damage (Table 2). Consuming an excessive amount of alcohol can be carcinogenic to people who consume too much alcohol. A study recently found that there was adequate evidence demonstrating that alcohol has the potential to cause cancer in animals and categorised alcoholic drinks as carcinogenic to humans (Zuckerman, 1995). Additionally, drinking alcohol has several negative effects. The treatment of pulmonary tuberculosis, the risk of lung cancer and several digestive malignancies, and all-cause and premature mortality are all affected by alcohol consumption (Meier and Seitz, 2008; Danpanichkul *et al.*, 2024). There is no confirmed evidence that 10% of tuberculosis is caused by alcohol consumption. However, there has been some evidence that alcohol consumption influences some infectious diseases, such as tuberculosis (Lönnroth *et al.*, 2008; Rehm and Parry, 2009). Nearly 10% of deaths worldwide among those aged 15 to 49 were caused by alcohol (Fang *et al.* 2022). These findings indicate that, surprisingly, a percentage of respondents still 'disagreed' that long-term consumption could cause cancer, damage the nervous system, and cause tuberculosis (Table 2). This further suggests that the level of education of drinkers can partially contribute to knowledge, attitude,

and perspective regarding drinking behaviour.

The findings of this study support the findings of other previous studies on a similar subject matter, indicating that gender does not show any association with alcohol consumption (Dietrich *et al.*, 2015). This is because males and females who prioritise their health are less likely to regularly drink alcohol. In contrast, the ethnicity of Borneo Malaysia was strongly connected with risky drinking (Mutalip *et al.*, 2014). Alcohol consumption is frequently linked to ethnic backgrounds and cultures (Kabwama *et al.*, 2016). This might also be true in some of the ethnic groups found in Malaysia, who practice drinking freely at festival occasions (Shoosmith *et al.*, 2016). The findings of this study also show that marital status has a significant association with the knowledge score, with an OR of 3.22 ( $p = 0.009$ ). A study shows that the average per capita income of singles is much lower than that of married couples in the same age group (Hawk, 2011). However, singles in their late twenties spend more than married couples, and single people spend more per person on housing, clothing, food, and entertainment, such as social drinking and movies (Hawk, 2011).

Based on the results of this study as shown in Table 4, there was a significant association between good knowledge and age such that respondents above 50 years old were more knowledgeable than those aged 30 - 50 years old, with an AOR of 4.09 ( $p = 0.047$ ). This is similar to the findings from a study that reported that young adults are more likely than older persons to engage in heavy episodic drinking (Hingson *et al.*, 2006). Another study had similar results, as Malaysians over the age of 50 had better knowledge scores, probably as a result of an expanded evaluation of the risk of contracting the condition and its complications (Azlan *et al.*, 2020). In addition, a study conducted in Nigeria and Ethiopia reported that age influences respondents' knowledge of health (Hamza *et al.*, 2017; Jimam and Ismail, 2020). This can result in alcohol dependence and a host of other detrimental effects later in life (Sandoval *et al.*, 2020). According to a report, risky drinking patterns were common among people aged 29 and younger and are characterised by irregular drinking patterns that result in excessive alcohol consumption (Assanangkornchai *et al.*, 2010). Risky drinking was also more predominant among lower socioeconomic groups despite lower consumption (Mutalip *et al.*, 2014). Older people may have experienced a longer period and may have learned more information regarding alcohol use and its effects.

According to a study, tertiary education is the most important indicator influencing healthcare among adult

education levels (Raghupathi and Raghupathi, 2020). The univariable analysis with a significant association between the knowledge score and educational achievement with tertiary education in Table 3 shows an OR of 3.48 ( $p = 0.017$ ). Risky drinking was more common among those with low educational attainment, and current drinking patterns peaked among those with high income and high educational attainment (Tomkins *et al.*, 2007). Another study found a substantial correlation between education level and dangerous drinking habits, with lower education levels being associated with a higher risk of heavy drinking than higher education levels (Tomkins *et al.*, 2007; Bich *et al.*, 2009). According to Table 4, there was a significant association that the tertiary education of the respondents was more knowledgeable than secondary education, with an AOR of 13.07 ( $p \leq 0.001$ ). This is similar to a study conducted in Syria, which stated that lower knowledge scores were significantly associated with lower education (Al Ahdab, 2021). Furthermore, a study conducted in Ethiopia found that respondents with low education had poor knowledge scores, while those with high levels of education had good knowledge scores (Adhena and Hidru, 2020). A study conducted in Korea concluded that a high level of education was significantly associated with good knowledge (Lee *et al.*, 2021). This result is supported by the fact that risky drinking was more prevalent among people with lower levels of education due to low self-esteem, feelings of insecurity, and a lack of economic and social stability (Tomkins *et al.*, 2007). Individuals can gain more detailed and in-depth knowledge about a variety of subjects, such as health awareness and the consumption of alcohol, through tertiary education. Higher education institutions frequently have wider levels of research facilities, databases, and libraries where students can access the most recent studies and information on alcohol consumption and its impact on health. Many universities provide specialised courses in public health, psychology, addiction studies, and epidemiology. These courses offer students disciplined and in-depth instruction on the effects of alcohol intake on their mental and physical well-being. Students in tertiary education frequently have the chance to learn from specialists in the field, such as professors who have performed alcohol-related research. This exposure to specialists can improve their comprehension and knowledge of alcohol health issues. Hence, education plays a vital role in providing knowledge towards health awareness.

There is a significant relationship between localities in Rumah Panjang Bare and Uma Belor, with OR of 3.41 ( $p = 0.038$ ) and 17.67 ( $p \leq 0.001$ ), respectively, and the knowledge score of the respondents based on Table 3. Similar results have been reported in a study that states

that environmental culture, which is permissive to alcohol consumption, influences individual alcohol consumption (Ahern *et al.*, 2008). Tuak consumers are not influenced by their family members but mainly by the environment in which they live (Sobhee *et al.*, 2015). There was a significant association between the good knowledge score and the localities in Rumah Panjang, with an AOR of 5.78 ( $p = 0.021$ ) and Uma Belor with an AOR of 22.69 ( $p \leq 0.001$ ), as shown in Table 4. This finding is similar to that of a study conducted in China that found that living near the city had a high knowledge score (Lai *et al.* 2021). Another study shows that locality has a positive impact on health knowledge (Tawalbeh *et al.*, 2021). This may be because of access to schools, places of worship, sports complexes, and other facilities to access knowledge. Other studies showed that individuals understand tuak as a traditional alcoholic drink that has positive and negative effects on its consumption (Ningsih and Sumiatin, 2020). Tuak is a beverage that can strengthen brotherhood and is always served in celebration of traditional parties and daily activities, so that it has an ingrained part of native society (Ningsih and Sumiatin, 2020). Residents present tuak as a typical drink to entertain visitors or guests, to welcome visitors and to make them feel at ease.

There is a significant relationship between household income below RM2500 with an AOR of 4.99 ( $p = 0.039$ ) and the knowledge score of the respondents based on Table 4. However, a study performed in Malaysia contradicts the present findings, where the knowledge scores of those with low monthly incomes were among the lowest due to insufficient time and reliable information available for lower-income people (Azlan *et al.*, 2020). Another study conducted in the United States shows that the income disparity and the prevalence of health knowledge are unrelated (Sturm and Gresenz, 2002). A study performed in Malaysia found a contrary relationship between income and knowledge score (Sabri *et al.*, 2022). In contrast, the present results from the study reveal that household income has a significant effect on the knowledge score. This may be due to the nature of our study, where we focused on tuak consumption, while previous studies focused on disease knowledge. Tuak is a traditional drink of Sarawak and is widely produced by low-income households because the preparation of tuak is cheaper than purchasing from a store. Low-income households sell tuak to gain extra income, which might help people of low income have more knowledge on tuak preparation.

#### 4. Conclusion

This survey has shown that most of the respondents were aware of the health effects of tuak consumption and

mainly showed satisfactory attitudes. The age, locality, level of education, and household income of respondents were found to be strong determinants of their knowledge of tuak consumption. However, the overall knowledge of tuak is inadequate among the respondents. Understanding the potential hazards and negative effects linked to excessive tuak intake is essential. Although most respondents are aware of their consumption limits, numerous short-term and long-term health issues, such as liver disease, pancreatitis, and cardiovascular consequences, can result from excessive drinking. In the future, this study can be expanded to other regions of Sarawak to understand the effect of tuak consumption in both the long term and short term for the whole population of Sarawak.

#### Conflict of interest

The authors declare no conflict of interest.

#### Acknowledgements

The authors gratefully acknowledge the financial support from the Ministry of Higher Education and Universiti Putra Malaysia for collaborative research under the Fundamental Research Grant Scheme (FRGS/1/2020/SKK0/UPM/02/15).

#### References

- Adhena, G. and Hidru, H.D. (2020). Knowledge, attitude, and practice of high-risk age groups to coronavirus disease-19 prevention and control in Korem district, Tigray, Ethiopia: cross-sectional study. *Infection and Drug Resistance*, 13, 3801-3809. <https://doi.org/10.2147/IDR.S275168>
- Ahern, J., Galea, S., Hubbard, A., Midanik, L. and Syme, S.L. (2008). "Culture of Drinking" and individual problems with alcohol use. *American Journal of Epidemiology*, 167(9), 1041-1049. <https://doi.org/10.1093/aje/kwn022>
- Al Ahdab, S. (2021). A cross-sectional survey of knowledge, attitude and practice (KAP) towards the COVID-19 pandemic among Syrian residents. *BMC Public Health*, 21(1), 296. <https://doi.org/10.1186/s12889-021-10353-3>
- Assanangkornchai, S., Sam-Angsri, N., Rerngpongpan, S. and Lertnakorn, A. (2010). Patterns of alcohol consumption in the Thai population: results of the national household survey of 2007. *Alcohol and Alcoholism*, 45(3), 278-285. <https://doi.org/10.1093/alcalc/agq018>
- Azlan, A.A., Hamzah, M.R., Sern, T.J., Ayub, S.H. and Mohamad, E. (2020). Public knowledge, attitudes and practices towards COVID-19: A cross-sectional

- study in Malaysia. *PLoS ONE*, 15(5), e0233668. <https://doi.org/10.1371/journal.pone.0233668>
- Baliunas, D.O., Taylor, B.J., Irving, H., Roerecke, M., Patra, J., Mohapatra, S. and Rehm, J. (2009). Alcohol as a risk factor for type 2 diabetes. *Diabetes Care*, 32(11), 2123-2132. <https://doi.org/10.2337/dc09-0227>
- Bich, T.H., Nga, P.T.Q., Quang, L.N., Van Minh, H., Ng, N., Juvekar, S., Razzaque, A., Ashraf, A., Ahmed, S.M., Soonthornthada, K. and Kanungsukkasem, U. (2009). Patterns of alcohol consumption in diverse rural populations in the Asian region. *Global Health Action*, 2(1), 2017. <https://doi.org/10.3402/gha.v2i0.2017>
- Bunyau, A.M. (2017). Tradisi Pembuatan Tuak Dalam Masyarakat Iban. Retrieved from website: <https://conference.uis.edu.my/pasak2017/images/prosiding/sosiologi/08-ANGELANE.pdf>
- Carolan, M. (Ed.) (2018). Food and culture. In *The Sociology of Food and Agriculture*, p. 137-159. UK: Routledge. <https://doi.org/10.4324/9781315670935-6>
- Danpanichkul, P., Suparan, K., Ng, C.H., Dejvajara, D., Kongarin, S., Panpradist, N., Chaiyakunapruk, N., Muthiah, M.D., Chen, V.L., Huang, D.Q., Diaz, L.A., Nouredin, M., Arab, J.P. and Wijarnpreecha, K. (2024). Global and regional burden of alcohol-associated liver disease and alcohol use disorder in the elderly. *Journal of Hepatology Reports: innovation in hepatology*, 6(4), 1-11. <https://doi.org/10.1016/j.jhepr.2024.101020>
- Firmando, H.B. (2020). Kearifan Lokal Minuman Tradisional Tuak Dalam Merajut Harmoni Sosial Di Tapanuli Bahagian Utara. *Aceh Anthropological Journal*, 4(2), 197-212. <https://doi.org/10.29103/aaj.v4i2.3121> [In Bahasa Indonesia].
- Hamza, T.A., Azmach, N.N. and Husen, A.A. (2017). Community knowledge, attitude and practice about malaria and mosquito biting behavior in southern Ethiopia. *American Journal of BioScience*, 5(5), 80-88. <https://doi.org/10.11648/j.ajbio.20170505.12>
- Hawk, W. (2011). By single persons and twenties: A comparison. *Consumer Expenditure Survey Anthology*, 1(1), 40-46.
- Hingson, R.W., Heeren, T. and Winter, M.R. (2006). Age at drinking onset and alcohol dependence. *Archives of Pediatrics and Adolescent Medicine*, 160(7), 739. <https://doi.org/10.1001/archpedi.160.7.739>
- Jimam, N.S. and Ismail, N.E. (2020). Predictors of patients' knowledge, attitudes and practices (KAP) regarding uncomplicated malaria in the primary healthcare facilities of Plateau state, Nigeria. *Journal of Health Research*, 34(4), 329-344. <https://doi.org/10.1108/JHR-06-2019-0125>
- Kabwama, S.N., Ndyabangi, S., Mutungi, G., Wesonga, R., Bahendeka, S.K. and Guwatudde, D. (2016). Alcohol use among adults in Uganda: findings from the countrywide non-communicable diseases risk factor cross-sectional survey. *Global Health Action*, 9(1), 31302. <https://doi.org/10.3402/gha.v9.31302>
- Kim, Y.G., Suh, B.W. and Eves, A. (2010). The relationships between food-related personality traits, satisfaction, and loyalty among visitors attending food events and festivals. *International Journal of Hospitality Management*, 29(2), 216-226. <https://doi.org/10.1016/j.ijhm.2009.10.015>
- Kramarow, E.A. and Tejada-Vera, B. (2022). Alcohol-induced deaths among adults aged 65 and over: United States, 2019 and 2020. NCHS Health E-Stats, p. 1-4. <https://doi.org/10.15620/cdc:122045>
- Langgat, J., Zahari, M.S.M., Yasin, M.S. and Mansur, N.A. (2011). The alteration of Sarawak ethnic natives' food: It's impact to Sarawak state tourism. Proceedings of Business and Economic Research Conference, Langkawi, Kedah, Malaysia.
- Lee, M., Kang, B.-A. and You, M. (2021). Knowledge, attitudes, and practices (KAP) toward COVID-19: a cross-sectional study in South Korea. *BMC Public Health*, 21, 295. <https://doi.org/10.1186/s12889-021-10285-y>
- Lönnroth, K., Williams, B.G., Stadlin, S., Jaramillo, E. and Dye, C. (2008). Alcohol use as a risk factor for tuberculosis – a systematic review. *BMC Public Health*, 8, 289. <https://doi.org/10.1186/1471-2458-8-289>
- Mohd Nor, N.M.S.N., Mohamed Idris, A.K., Hashim, N., Tarmazi, S.A.A. and Dawi, S.D.B. (2020). A study of Sarawak ethnic food “Tuak” as means of communication in understanding culture. *GADING*, 23(01), 1-5.
- Meier, P. and Seitz, H.K. (2008). Age, alcohol metabolism and liver disease. *Current Opinion in Clinical Nutrition and Metabolic Care*, 11(1), 21-26. <https://doi.org/10.1097/MCO.0b013e3282f30564>.
- Mutalip, M.H.B.A., Kamarudin, R., Manickam, M., Abd Hamid, H.A. and Saari, R. (2014). Alcohol consumption and risky drinking patterns in Malaysia: findings from NHMS 2011. *Alcohol and Alcoholism*, 49(5), 593-599. <https://doi.org/10.1093/alcalc/agu042>
- Nile, S.H. (2015). The nutritional, biochemical and health effects of makgeolli - a traditional Korean fermented cereal beverage. *Journal of the Institute of*

- Brewing*, 121(4), 457-463. <https://doi.org/10.1002/jib.264>
- Ningsih, W.T. and Sumiatin, T. (2020). Determinant analysis of factors influencing Tuak consumption culture on guardian earth through the leininger model sunrise approach theory. *Medico-Legal Update*, 20(4), 1429-1433. <https://doi.org/10.37506/mlu.v20i4.2032>
- Md. Nor, N., Md. Sharif, M.S., Mohd Zahari, M.S., Mohd Salleh, H., Isha, N. and Muhammad, R. (2012). The transmission modes of Malay traditional food knowledge within generations. *Procedia - Social and Behavioral Sciences*, 50, 79-88. <https://doi.org/10.1016/j.sbspro.2012.08.017>
- Organ, K., Koenig-Lewis, N., Palmer, A. and Probert, J. (2015). Festivals as agents for behaviour change: A study of food festival engagement and subsequent food choices. *Tourism Management*, 48, 84-99. <https://doi.org/10.1016/j.tourman.2014.10.021>
- Oсна, N.A., Donohue, T.M. and Kharbanda, K.K. (2017). Alcoholic liver disease: pathogenesis and current management. *Alcohol Research: Current Reviews*, 38(2), 147-161. <https://doi.org/28988570>
- Palaniveloo, K. and Vairappan, C.S. (2013). Biochemical properties of rice wine produced from three different starter cultures. *Journal of Tropical Biology and Conservation*, 10(3), 31-41. <https://doi.org/10.51200/jtbc.v10i.252>
- Penning, R., McKinney, A. and Verster, J.C. (2012). Alcohol hangover symptoms and their contribution to the overall hangover severity. *Alcohol and Alcoholism*, 47(3), 248-252. <https://doi.org/10.1093/alcalc/ags029>
- Raghupathi, V. and Raghupathi, W. (2020). The influence of education on health: an empirical assessment of OECD countries for the period 1995–2015. *Archives of Public Health*, 78, 20. <https://doi.org/10.1186/s13690-020-00402-5>
- Rehm, J. and Parry, C. (2009). Alcohol consumption and infectious diseases in South Africa. *The Lancet*, 374 (9707), 2053. [https://doi.org/10.1016/S0140-6736\(09\)62150-4](https://doi.org/10.1016/S0140-6736(09)62150-4)
- Roerecke, M., Vafaei, A., Hasan, O.S.M., Chrystoja, B.R., Cruz, M., Lee, R., Neuman, M.G. and Rehm, J. (2019). Alcohol consumption and risk of liver cirrhosis: A systematic review and meta-analysis. *American Journal of Gastroenterology*, 114(10), 1574-1586. <https://doi.org/10.14309/ajg.0000000000000340>
- Sabri, M.F., Said, M.A., Magli, A.S., Pin, T.M., Rizal, H., Thangiah, N., Ithnin, M., Abdul Majid, H., Ismail, R., Su, T.T. and Husniyah, A.R. (2022). Exploring the relationships of financial literacy and financial behaviour with health-related quality of life (HRQOL) among the low-income working population in Malaysia during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 19(19), 12520. <https://doi.org/10.3390/ijerph191912520>
- Salehuddin, M., Zahari, M., Syaquif, M., Mohd, Y.K., Kutut, Z. and Langgat, J. (2011). The level of alteration of ethics native food: (a case of Sarawak, Malaysia). *International Journal of Humanities and Social Science*, 1(6), 137-144.
- Sandoval, G.A., Monteiro, M.G., De Pinho Campos, K., Shield, K. and Marinho, F. (2020). Sociodemographics, lifestyle factors and health status indicators associated with alcohol consumption and related behaviours: a Brazilian population-based analysis. *Public Health*, 178, 49-61. <https://doi.org/10.1016/j.puhe.2019.08.011>
- Shimoga, G. and Kim, S.-Y. (2022). Makgeolli - The traditional choice of Korean fermented beverage from cereal: an overview on its composition and health benefits. *Food Science and Technology*, 42, e43920. <https://doi.org/10.1590/fst.43920>
- Shoosmith, W.D., Oo Tha, N., Naing, K.S., Abbas, R.B.H. and Abdullah, A.F. (2016). Unrecorded alcohol and alcohol-related harm in rural Sabah, Malaysia: a socio-economically deprived region with expensive beer and cheap local spirits. *Alcohol and Alcoholism*, 51(6), 741-746. <https://doi.org/10.1093/alcalc/aggw005>
- Sinaga, S.Y. and Salim, T.A. (2019). Knowledge preservation of Tuak as Batak Toba social community culture. *International Review of Humanities Studies*, 4(1), 415-419. <https://doi.org/10.7454/irhs.v4i1.151>
- Sobhee, S., Kaseeah, H., Tandrayen-Ragoobur, V. Gopaul, A. (2015). An empirical analysis of the determinants of expenditure on alcohol by alcohol dependent individuals in Mauritius. *Drugs and Alcohol Today*, 15(3), 158-172. <https://doi.org/10.1108/DAT-12-2014-0040>
- Sturm, R. and Gresenz, C.R. (2002). Relations of income inequality and family income to chronic medical conditions and mental health disorders: national survey. *BMJ*, 324, 20. <https://doi.org/10.1136/bmj.324.7328.20>
- Subramaniyan, V., Chakravarthi, S., Jegasothy, R., Seng, W.Y., Fuloria, N.K., Fuloria, S., Hazarika, I. and Das, A. (2021). Alcohol-associated liver disease: A review on its pathophysiology, diagnosis and drug therapy. *Toxicology Reports*, 8, 376-385. <https://doi.org/10.1016/j.toxrep.2021.02.010>

- Sukirman, A.N., Khalex, H.B., Mustafa, S., Sarbini, S.R., Hassan, S., S-Hussain, S.S., Ahmad, I., Hassan, Z., Altwaim, S.A. and Kamaludeen, J. (2020). Umai dish preparation practices and food safety behaviors in Bintulu locals on Borneo Island, Malaysia. *Journal of Food Protection*, 83(10), 1764-1774. <https://doi.org/10.4315/JFP-19-543>
- Tawalbeh, L.I., Al-Smadi, A.M., Ashour, A., Alshajrawi, A., Gammoh, O. and Abu-Al-Rous, N. (2021). Public knowledge, attitudes and practice about COVID-19 pandemic. *Journal of Public Health in Africa*, 12(2) 1519-1526. <https://doi.org/10.4081/jphia.2021.1519>
- Tomkins, S., Saburova, L., Kiryanov, N., Andreev, E., McKee, M., Shkolnikov, V. and Leon, D.A. (2007). Prevalence and socio-economic distribution of hazardous patterns of alcohol drinking: study of alcohol consumption in men aged 25-54 years in Izhevsk, Russia. *Addiction*, 102(4), 544-553. <https://doi.org/10.1111/j.1360-0443.2006.01693.x>
- Wong, B., Muchangi, K., Quach, E., Chen, T., Owens, A., Otter, D., Phillips, M. and Kam, R. (2023). Characterisation of Korean rice wine (makgeolli) prepared by different processing methods. *Current Research in Food Science*, 6, 100420. <https://doi.org/10.1016/j.crfs.2022.100420>
- Zuckerman, A.J. (1995). IARC monographs on the evaluation of carcinogenic risks to humans. *Journal of Clinical Pathology*, 48(7), 691-691. <https://doi.org/10.1136/jcp.48.7.691-a>