Alcohol consumption and risk of type 2 diabetes mellitus among males in The Manggis Area, Karangasem, Bali

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ABSTRACT

Background and purpose: Diabetes mellitus (DM) is a serious health problem worldwide. Local alcohol consumption is one of Balinese's traditions considered to be associated with the high incidence of DM. This study aims to determine the pattern of alcohol consumption and risk of type 2 DM in Manggis Subdistrict, Karangasem, Bali.

Methods: A case control study was conducted in 55 men with type 2 DM as cases and 55 non-diabetic men as controls. Non-diabetic men were defined with fasting glucose level (GDP) <100 mg/dl and without clinical symptoms of DM. Cases were recruited from the patient's register at the public health centre (PHC) in Manggis Sub-District and controls were recruited from similar neighborhood with the cases and matched by age. Data were collected over May-July 2017 by households' interview using structured questionnaires. Multivariate analysis was employed using logistic regression to identify the risk factors of type 2 DM.

Results: The characteristics of cases and controls were similar in terms of age, education and physical activity, but there was a significant difference in employment. Multivariate analysis showed that heavy alcohol consumption (AOR=7.84; 95%CI: 1.46-42.28), frequent consumption of high sugar alcohol drinks (AOR=3.45; 95% CI: 1.16-10.22), history of obesity (AOR=8.82; 95% CI: 2.43-32.01), employed (AOR=5.98; 95%CI: 1.89-18.93) and frequent consumption of sweetened beverages (AOR=39,57; 95%CI: 4.00-391,8) were significantly associated with the incidence of type 2 DM. No significant association was found between the duration of alcohol consumption and the incidence of type 2 DM.

Conclusions: Alcohol consumption, a history of obesity, consumption of high sugar alcohol drinks, retirement/unemployment and consumption of sweetened beverages are associated with the incidence of type 2 DM. Education regarding those risk factors should be enhanced to reduce the incidence of type 2 DM.

Keywords: Type 2 DM, alcohol consumption, obesity, Bali

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INTRODUCTION

Diabetes mellitus (DM) is a major global public health problem and 90% of all cases of diabetes in the world are DM type 2.[1] The International Diabetes Federation (IDF) estimates that by 2013 the number of adults living with diabetes in the world reached 382 million. This number is expected to increase to over 592 million in less than 25 years. IDF data shows that in 2013 the proportion of diabetics in Indonesia was 8.5 million people or 4.81% of the population, therefore Indonesia ranked among the top 10 countries with the highest rate of diabetes in the world.[2] The 2007 Indonesia Basic Health Research (*Riskesdas*) also shows that the prevalence of DM in Indonesia was greater than the IDF estimate of 5.7% or equal to 9.35 million of the total population aged >15 years.[3] The 2013 Indonesia Basic Health Research (*Riskesdas*) shows an increase in the proportion of DM in Indonesia to 6.9% or equal to 12.19 million of the total population aged >15 years.[4]

Studies on DM risk factors have been conducted widely. Several studies have shown that there are risk factors, which cannot be modified including genetics, age, sex and history of low birth weight. Other risk factors can be modified which include obesity, diet, physical activity and dyslipidemia.[5,6,7,8,9] Several studies have shown that high alcohol consumption can increase the risk of DM type 2 and this risk factor can be modified.[10,11] Alcohol consumption in Indonesia is arguably high, especially in rural areas. Alcoholic beverages that are often consumed in rural and village contexts are those using traditional distilling methods.[12,13]

According to The 2013 Indonesia Basic Health Research (*Riskesdas*), the prevalence of DM in Bali was 1.5%.[4] Although the figure is lower than the national estimate,[3,4] The 2007 Indonesia Basic Health Research (*Riskesdas*) indicated that Bali Province is included in 15 provinces that have a high proportion of alcohol consumption, that is

above the national estimate.[3] Karangasem, one of the eight districts in Bali, reports an increase in the prevalence of diabetics from 0.4%[14] in 2007 to 1.0%[15] in 2013. The 2007 Bali Province Basic Health Research (*Riskesdas*) showed that this district has the highest proportion of alcohol consumption compared to other districts, and higher than the Bali as well as national estimates. The proportion of alcohol consumption in the past 12 months in 2007 for Karangasem was 10.7% and the 1st month was 9.1%.[14] Karangasem has eight sub-districts, one of which is Manggis.[16] Data from the Karangasem Health Office indicated that most diabetic patients presented at the Manggis I Public Health Center.[17] In addition, it is important to note, that this district is one of the key producers of traditional palm wine, or *tuak* on the island. Other than being *tuak* distillers, the consumption of the beverage in this area seems also high; as evidenced by a study in one of the villages indicating that at least 53.18% of the total 222 respondents had consumed *tuak*.[18]

Tuak is a traditional alcoholic beverage made by tapping the sap of the sugar palm tree. The sap is extracted and collected by a tapper and the white sappy liquid, *nira* that initially collects tends to be very sweet and non-alcoholic before it is fermented. A study in Indonesia[19] indicated that after fermented, *nira* consists of water (80-90%), sucrose (12.30-17.40%), sugars (0.5-1%) and other ingredients (1.5-7%), therefore *tuak* can be classified as an alcoholic beverage with high sugar content.[19] This study aims to identify the association between alcohol consumption, specifically *tuak*, and type 2 DM.

METHODS

A case control study was conducted with data collected from May to July 2017 in the Manggis Sub-District. Cases were 55 men aged 40-80 years who were diagnosed with type 2 DM by doctors at the Manggis Sub-District PHC, and reside in Manggis Sub-District. Controls were 55 males who had undergone blood glucose fasting (GDP) with glucose levels <100mg/dl and had no DM clinical symptoms. They were recruited from similar neighborhood with the case and matched by age.

Data collected were education, occupation, alcohol consumption (type, duration and amount), obesity, diet history and physical activity. Data were collected by interview in the house of respondents using a standardized questionnaire. Informed consents were obtained prior to the interviews.

Questionnaire for alcohol consumption were modified from WHO STEPs Instrument.[20] Duration of alcohol consumption is categorized to be <30 years, and ≥30 years. Among cases, the duration of alcohol consumption is determined from the first alcohol intake to the time of DM diagnosis, whereas among controls, it is determined until the time of the study. Three categories were established for the amount of alcohol consumption: non-drinkers/light drinkers (<0.052-1.0 gram/day), moderate drinkers (1.14 to 5.2 gram/day) and heavy drinkers (>5.2 gram/day). The amount of alcohol consumption was obtained by converting the highest amount of alcohol consumed by type of alcoholic beverage and the frequency of consumption. Types of alcoholic drinks were categorized as high and low sugar. High sugar alcohol includes only palm wines (*tuak*), while the others included in the low sugar.

Diet was measured using modified Food Frequency Questionnaire (FFQ).[21] Different types of food/beverages were questioned on the last 30 days of consumption. The frequency of consumption was categorised as never, 0-3 times/month, 1-3 times/week, 4-6 times/week, 1 time/day and more than one time/day. History of diet among case group was explored before the diagnosis of DM established, while among controls explored on the last 30 days. The frequency of food consumption was grouped into rarely (0-12/month) and often. Rarely category referred to a combination of never, 0-3×/month and 1-3x/week. The often category (>12×/month) referred to a combination of three other categories: 4-6×/week, 1x/day and >1x/day.

Physical activity was measured using the Global Physical Activity Questionnaire (GPAQ) which consisted of work, recreation, exercise, movement and physical inactivity.[22] Physical activity was converted to metabolic equivalent (Met) value, and then calculated for 7 days using formula available in the GPAQ. It is categorized as sufficient (≥600 Met minutes/week) and low (<600 Met minutes/week).

Data analysed using STATA SE 12.1 and multivariate analysis was employed using logitic regression to identify the association between alcohol consumption with type 2 DM. Variables included in the multivariate model are those having p value <0.25 in bivariate analysis.

This study obtained Ethics Clearance by the Human Research Ethic Committee Faculty of Medicine Udayana University/Sanglah General Hospital Denpasar on May 18, 2017.

RESULTS

Table 1 presents the characteristics of cases and controls by age, education, occupation, and level of physical activity. It is showed that there is no significant difference (p>0,05) between cases and controls by age, education and physical activity. However, there is a significant difference by employment (p<0.05).

Table 2 shows the crude odd ratio (OR) of alcohol consumption patterns (length, type and amount of alcohol intake), employment, obesity and diet history (sweet drinks, sugar, vegetable and protein intake, use of oil and intake of fried food). Variables significantly associated with with type 2 DM were heavy alcohol consumption (OR=6.59; 95%CI:1.76-24.71), high sugar alcoholic beverages (*tuak*) (OR=3,11; 95%CI: 1.42-6.81), obesity (OR=5.87; 95%CI: 2.15-16), employed (OR=4.03; 95%CI: 1,7-9,6) and sweet drink consumption (OR=20,25; 95%CI: 2,57-159,7).

Variables with p value <0.25 was included in the multivariate analysis. Table 3 shows that variables significantly associated with type 2 DM were heavy drinker (AOR=7.84, 95%CI: 1.46-42.28), high sugar alcoholic beverage intake (AOR=3.45; 95%CI: 1.16-10,22), obesity (AOR=8.82; 95%CI: 2.43-32.01), employed (AOR=5.98; 95%CI: 1.9-18.9) and consumption of sweet drinks (AOR=39.57; 95%CI: 4.0-391.8).

DISCUSSION

This study indicates that heavy alcohol drinkers, high sugar alcohol (*tuak*) consumption, obesity, employed and high sugar drink consumption are risk factors for type 2 DM. Our study shows that the consumption of alcohol in large amounts increases the risk of type 2 DM. A study conducted in Japan, found that men aged 35-61 years who were heavy alcohol drinkers were at risk for type 2 DM. Another study in Texas, found that the risk of type 2 DM doubled with high alcohol consumption when compared with moderate alcohol consumption.

A study in the United States showed that heavy alcohol consumption had an impact on liver damage or chronic pancreatitis,[23] which could potentially lead to type 2 DM.

Our study shows that the level of *tuak* intake in both groups studied was high. This is consistent with two previous studies stating that traditional alcoholic drinks such as palm wine (*tuak*) are mostly consumed in rural areas,[12] and have become part of tradition, during custom celebrations, parties and daily activities.[13] In our knowledge, there is no publication in Indonesia related to the consumption of *tuak* or traditional alcoholic beverages and the risk of type 2 DM. Previous study related to *tuak* in Tegallinggah Village, Karangasem, Bali found that *tuak* consumption increased the risk of obesity,[18] which is also known as one of the DM risk factors. Our findings are not consistent with the two previous studies in the United States wherein the type of alcoholic beverages consumed had no effect on the incidence of DM.[24,23] This disparity may be due to differences in alcoholic beverages in both regions and other diverse consumption pattern characteristics.

In our study, obesity has also been shown to significantly increase the risk of type 2 DM. This finding consistent with a number of previous studies in some areas of Indonesia, namely in South

Table 1   Characteristics of cases and controls

Characteristic	Cases		Controls		p value
	n	%	n	%	
Age (years)					
40-49	2	3.64	3	5.45	
50-59	21	38.18	18	32.73	
60-69	22	40.00	26	47.27	
70+	10	18.18	8	14.55	0.805
Education					
Elementary	28	50.91	31	56.36	
Junior high school	3	5.45	4	7.27	
Senior high school	8	14.55	12	21.82	
University	16	29.09	8	14.55	0.288
Employment					
Retired/unemployed	29	52.73	45	81.82	
Employed	26	47.27	10	18.18	0.001
Physical activity					
Sufficient(≥600 Met minute/week)	51	92.73	54	98.18	
Insufficient (<600 Met minute/week)	4	7.27	1	1.82	0.170

Table 2 Crude OR of alcohol consumption, obesity, employment and diet

Variables	Cases		Controls		OR	p value
	n	%	n	%		
Alcohol intake/amount						
Light (<0,052-1,09 gr/day)	34	61.82	48	87.27	Ref.	
Moderate (1,14-5,2 gr/day)	7	12.73	4	7.27	2.47	0.174
Heavy (>5,2 gr/day)	14	25.45	3	5.45	6.59	0.005
High sugar alcohol (tuak) intake						
No	17	30.91	32	58.18		
Yes	38	69.09	23	41.82	3.11	0.005
Duration of alcohol intake						
<30 yrs	21	38.18	32	58.18		
≥30 yrs	34	61.82	23	41.82	2.25	0.037
Obesity						
No		58.18	49	89.09		
Yes	3223	41.82	6	10.91	5.87	0.001
Employment						
Retired/unemployed	29	52.73	45	81.82		
Employed	26	47.27	10	18.18	4.03	0.002
High sugar drink intake						
Rarely (0-12x/month)	40	72.73	54	98.18		
Often (>12x/month)	15	27.27	1	1.82	20.25	0.004
Sugar intake						
Rarely (0-12x/month)	11	20.00	21	38.18		
Often (>12x/month)	44	80.00	34	61.82	2.47	
Protein intake						
Rarely (0-12x/month)	46	83.64	28	50.91		
Often (>12x/month)	9	16.36	27	49.09	0.20	
Oil intake						
Rarely (0-12x/month)	1	1.82	7	12.73		
Often (>12x/ month)	54	98.18	48	87.27	7.88	
Fried food consumption						
Rarely (0-12x/ month)	1	1.82	9	16.36		
Often (>12x/ month)	54	98.18	46	83.64	10.57	

Denpasar, Bali;[7] in Semarang, Central Java,[8] and Manado, Sulawesi.[6]

Employment has also been shown as a significant risk factor on type 2 DM, whereas those who are employed are more likely to develop type 2 DM. This finding is not consistent with other study in Denpasar, Bali which shows that employment was not associated with type 2 DM.[7]

This study also found that the consumption of high sugar drinks is a factor that increases the risk of type 2 DM. This finding is consistent with studies in Semarang, Central Java[8] and Jakarta.[9]

The limitations of this study is the possible information bias to recall the history of alcohol consumption which relies on the respondent's memory. In addition, the amount of alcohol consumption is determined by conversion from glass/bottle to ml size and then converted to gram, and there was a variation in the size of glass and bottle used by respondents. Another information bias identified was the history of obesity which was determined by interviews. This study only cover a limited area in one sub-district, thus generalization to the wider population should be taken with caution.

Table 3 Association between some variables with type 2 DM

Variables	Adjusted OR	95%CI
Alcohol intake/amount		
Light (<0,052-1,09 gr/day)	1 (Ref)	
Moderate (1,14-5,2 gr alcohol/day)	5.07	0.98-26.15
Heavy (>5,2 gr alcohol/day)	7.84	1.46-42.28
High sugar alcohol intake (tuak)		
No	1 (Ref)	
Yes	3.45	1.16-10.22
Obesity		
No	1 (Ref)	
Yes	8.82	2.43-32.01
Employment		
Retired/unemployed	1 (Ref)	
Employed	5.98	1.89-18.93
High sugar drink intake		
Rarely (0-12x/month)	1 (Ref)	
Often (>12x/month)	39.57	4.00-391.8

CONCLUSION

Alcohol consumption, obesity, consumption of high sugar alcohol drinks, employment and consumption of sweetened beverages are associated with the incidence of type 2 DM. Education regarding alcohol consumption, especially the high sugar alcohol drinks in preventing type 2 DM should be enhanced mainly in areas known to have traditional alcohol consumption habits.

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