

Original Article

Alcohol Intake: A Risk to Develop Type-2 Diabetes Mellitus-Think Before You Drink

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Abstract

Objective: A toxic substance, alcohol is psychotropic in nature and bears dependence producing propensities. The excessive use of alcohol is a global health concern and the world's leading risk factor for disease and disability. This study aim was to investigate the link between alcohol intake and occurrence of type 2 diabetes mellitus (T2DM) amongst male and female alcohol users.

Methods: In this study 52 original studies were recognized using search engines including “Medline”, “Web of Science”, “Pub-Med”, “Scopus” and “EMBASE” using various keywords like “alcohol intake”, “alcohol consumption”, “incidence”, “Diabetes Mellitus”, “type-2 Diabetes Mellitus”. Finally, 12 original research articles were included with a total sample size of 182,422, from them 120243 (65.92%) were males and 62179 (34.08%) were females. T2DM pooling incidence was analyzed using random and fixed model effects.

Results: The prevalence of Type 2 diabetes mellitus among male alcohol users was 7% with 95% confidence interval (5%-11%). However, the prevalence of T2DM among female alcohol users was 6% with 95% confidence interval (5%-9%). The pooled incidence of T2DM was higher in males compared to females.

Conclusion: Alcohol intake is a risk to develop T2DM. The findings have a general message for the global health community on the potential harms of alcohol intake on T2DM. A healthy lifestyle pattern could be adopted and alcohol governing policies should be implanted. Health educational awareness programs should be introduced to highlight the hazardous effects of alcohol and its association with T2DM. Alcohol users must think before to drink.

Keywords: Alcohol, Type 2 Diabetes Mellitus, Prevalence.

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Introduction

Alcohol is a toxic and psychotropic liquid consisting properties of dependence producing. Alcohol has been widely used in many cultures,¹ and has been considered as a part of social activities². Alcohol intake is one of the major public health challenges facing modern society. The swift economic development and a rise in average socio-economic level increase the trends

of alcohol intake. During the last three decades, there has been a rapid increase in alcohol production, importation, availability and consumption.²

The excessive use of alcohol is a global leading health problem and has social and economic burden economic burden in the societies. Abusing alcohol is reported to be amongst five topmost risk factors for ailments, disability and

death globally. The detrimental alcohol use is a cause of more than two hundred illness and injurious conditions.^{1,3} Alcohol intake can cause various health problems, impair various physiological functions and develop metabolic dysfunctions.^{4,5}

Diabetes Mellitus (DM) is a most challenging health issue of the 21st century.⁶ Worldwide, the incidence of diabetes mellitus has augmented dramatically. Diabetes mellitus is a multifactorial syndrome,^{7,8} few ways of life and attitudes like low physical activities and diets contained with high fat lead to obesity and increase risk of type 2 DM.⁸ A less attention have been given to observe alcohol consumption and risk of T2DM. Therefore, the present study was conducted to investigate the association between alcohol intake and prevalence of type 2 Diabetes Mellitus.

Subjects and Methods

In this study a descriptive approach was employed to explore the relationship between alcohol intake and new cases of T2DM among men and women. Prevalence of T2DM was selected as the outcome; The diagnostic criteria was followed as per international guidelines based on American Diabetes Association and World Health Organizations. Initially 52 articles were published between the period Jan 1970-June 2019 on the prevalence and incidence of Diabetes Mellitus which were identified from "Pub-Med, Medline, EMBASE, Web of Science, and Scopus databases". The relevant studies were explored through the keywords including "alcohol intake", "alcohol consumption", "prevalence", "incidence", "type-2 Diabetes Mellitus" and "Diabetes Mellitus". The relevance of studies was determined by the title and abstract of the article. After the eligible studies had been short listed, the appropriate characteristics and findings were recorded by an investigator and verified by another investigator, the inconsistency of appraisal was resolved through the feedback of the third investigator and majority decision was permitted where a publication was reviewed by a third investigator. The findings including sample size, age, gender, numbers, incidence, and length of follow-up were noted. The articles were carefully analyzed for

the prevalence of T2DM among male and females, and data were recorded.

The present analysis was based on the prospective, case-cohort, longitudinal community based 12 studies and explored all possible relations between alcohol intake and the prevalence of T2DM. The total number of participants were 182,422, among them males were 120243 (65.92%) and females were 62179 (34.08%) with age ranges 18-98 years and the median follow up period was about 9.0 years.

Inclusion and exclusion criteria: The inclusion criteria of literature was based on the population based studies from all over the world in which documents contained information about "incidence", "type 2 Diabetes Mellitus" and alcohol users both male and females. The study must be available in peer review journals mainly the journals indexed in PubMed and ISI Web of Science. The articles such as brief communications, non-observational correspondence, review articles were not included and duplicate publications were also omitted. The articles were verified under pre-determined inclusion and exclusion standards. Fifty-two studies were analyzed, finally 12 articles were selected in the analysis and discussion was added with related documents and remaining studies were excluded.

Ethics Statement: In this study the data associated to the incidence of T2DM was acquired from different databases, subjects or patients were not directly involved, and therefore ethical approval was not required.

Statistical Analysis: A pooled incidence of T2DM was measured using random and fixed model effects. An R-foundation for statistical computation was used to perform analysis and incidence of T2DM was recorded. The *p*-value less than 0.05 was considered a significant.

Results

Initially 52 articles were published between the period Jan 1970- June 2019 on the prevalence of diabetes mellitus which were identified from "Pub-Med, Medline, EMBASE, Web of Science, and Scopus databases". After the eligible studies had been short listed, the appropriate characteristics and findings of 12 studies were analyzed. The characteristics of 12 studies are presented in (Table-I and II). All these studies

included both male and females. In these studies the average follow up period was 9 years. The total sample size of these studies was 182422, number of males was 120243 (65.92%) and number of females was 62179 (34.08%). Based on the random effect model the incidence of T2DM among men and women was recorded.

The incidence of T2DM among male alcohol users was 7% with 95% confidence Interval 5% - 11%. However, the incidence of T2DM among female alcohol users was 6% with 95% confidence interval was 5%-9%. The pooled incidence of T2DM was higher in males compared to females (**Fig- I, Table II**).

Table-1: Literature related to alcohol intake and prevalence of Type 2 Diabetes Mellitus.

Author(s) and Year of Study	Sample size	Age Years	Type of Study	Outcome
Han et al ⁹	M=5617	≥18	Prospective cohort	M= 376/ 5617=6.69%
	F=6569		MFP:18 years	F= 292/ 5617=5.19%
	Total: 12186			Total: 668/ 12186=5.48%)
Knott et al ¹⁰	M=5723	35-55	Prospective cohort	M= 620/ 5723=10.83%
	F=6569		MFP:9.9 years	F= 269/ 2569=10.47%
	Total: 8292			Total: 889/ 8295=10.72%)
Kerr et al ¹¹	M=4020	21-55	Prospective cohort	M= 418/4020 (10.39%)
	F=4269		MFP:10 years	F= 482/4269 (11.2%)
	Total: 8289			Total: 900/8289=10.85%
Lim et al ¹²	M=7489	≥30	Cross Sectional	M= 429 /7489= 5.72%
	F=8900			F= 348/8900=3.91%
	Total: 16389			Total: 777/16389=4.74%
Peng et al ¹³	M=2273	≥50	Prospective cohort	M= 393/ 2273=17.28%
	F=2263			F= 328/5563=14.49%
	Total: 4536			Total: 721/4536=15.89%
Holst et al ¹⁴	M=28704	18-98	Prospective cohort	M= 859/ 28704=2.99%
	F=41847		MFP:4.9 years	F= 887/ 41847=2.11%
	Total: 70551			Total: 1746/ 70551=2.47%)
Koloveryou et al ¹⁵	M=1514	18-89	Prospective cohort	M= 859/ 28704=2.99%
	F=1528		MFP:10 years	F= 887/ 41847=2.11%
	Total: 3042			Total: 1746/ 70551=2.47%)
Hong et al ¹⁶	M=5551	44-48	Prospective cohort	M= 511/ 5551=9.2%
	F=6935		MFP:NA	F= 374/ 6935=5.4%

	Total: 12486			Total: 885/ 12486=7.08%)
Liang & Chikritzhs¹⁷	M=1303	12-28	Prospective cohort	M= 73 (536%)
	F=1547		MFP:15 years	F= 99 (6.39%)
	Total: 2850			Total: 172 (6.03%)
Djoussé et al¹⁸	M=1386	64-95	Prospective cohort	M= 51/ 1386=3.67%
	F=1261		MFP:6.4 years	F= 72/ 1261=5.66%
	Total: 4655			Total: 123/ 2847=4.32%)
Waki et al¹⁹	M=12913	40-59	Prospective cohort	M= 703/ 12913=5.44%
	F=15980			F= 482/ 15980=3.10%
	Total: 28893			Total: 1185/ 28893=4.10%)
Kao et al²⁰	M=5423	45-64	Prospective cohort	M= 478/ 5423=8.81%
	F=6823		MFP:6 years	F= 333/ 6938=4.86%
	Total: 12261			Total: 811/ 12261=6.64%)

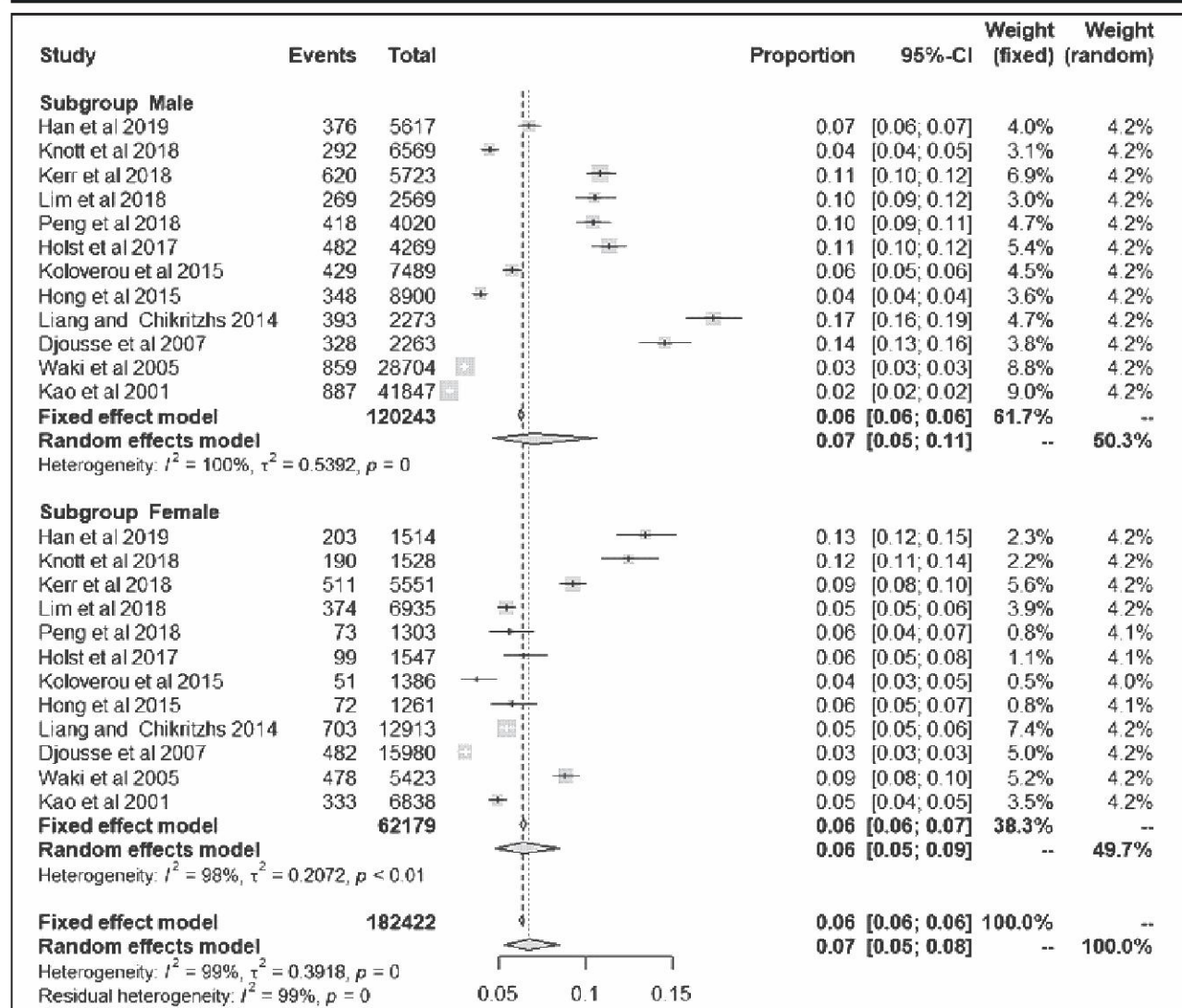
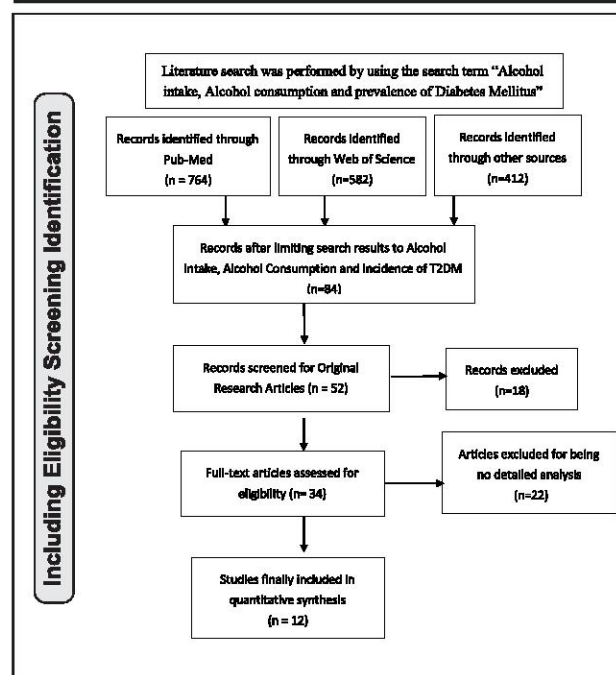


Fig-I: Pooled prevalence of type 2 diabetes mellitus among male and female alcohol users.

Table-2: Gender distribution and pooled prevalence of T2DM.

Gender	Sample Size	95% Confidence Interval	Pooled Incidence of T2DM
Male	120243	5% - 11%	7%
Female	62179	5% - 9%	6%
Total	182422	5% - 8 %	7%%

**Fig-II:** PRISMA Flow Diagram for the Selection of Studies with alcohol intake and prevalence of Type 2 Diabetes Mellitus.

Discussion

The present study identified that alcohol intake is a risk to develop type 2 Diabetes Mellitus in male and females. The "International Diabetes Federation's Atlas, 2019"²¹ displays new statistics and demonstrated that global overall prevalence of diabetes is 9.3% showing that 463 million adult people are diabetics. However, in the present study we found the occurrence of T2DM among male alcohol users was 7% with 95% confidence Interval 5%-11% and among female alcohol users was 6% where 95% confidence interval was 5%-9%. The incidence of T2DM was higher in males compared to females (Table II).

Peng et al¹³ assessed the causality between alcohol intake, diabetes risk among 4536 participants. In this randomization, study authors identified that high alcohol intake was causally coupled to insulin resistance and increased risk of

diabetes mellitus. Similarly, Lai et al²² conducted a study in Taiwanese population and established a link between frequency of alcohol intake and risk of diabetes. The study population was 43,000, with 9-year follow-up period, incidence of diabetes was 3650 (8.49%). The risk of diabetes was significantly higher among regular heavy drinkers.

Hodge et al²³ demonstrated the rising risk of DM in men who consumed ≥ 210 g alcohol during 03 days in a week compared with men who consumed no alcohol. Moreover, a study conducted on 1650 Japanese men without diabetes, identified that drinking more than three beverages per diem remarkably surged the danger of DM. In another community-based cohort of 12,261 participants, reported a significant higher risk of diabetes among men who consumed more than 21 beverages a week as compared to the men consumed ≤ 1 drink a week.²⁰ Further literature has reported that low consumption of alcohol is associated with lower risk of DM²⁴ while substantial alcohol consumption had greater association with elevated risk of DM.²⁵

Vancampfort et al²⁶ conducted a meta-analysis and described the pooled prevalence of T2DM in people with alcohol use was 12.4%, higher T2DM prevalence was observed among male participants. Similarly, in the present study, we found high incidence of T2DM among males compared to female. Marques-Vidal et al²⁷ investigated the association of alcohol intake on the incidence of T2DM and IFG. The authors recruited 4765 individuals, 2152 male and 2613 female with mean age of 52 years, followed for an average of 5.5 years. During the follow-up, 5.96% participants developed T2DM and 13.49% developed IFG. The overall findings demonstrates that alcohol consumption was positively associated with the risk of developing T2DM. Cullmann et al²⁸ assessed the association between alcohol and risk of developing pre-diabetes and T2DM in men and women. The authors recruited 2070 men and 3058 women and identified that total alcohol intake increased the risk of pre-diabetes and T2DM in men. In the present study we also identified that alcohol intake is associated with high incidence of T2DM among males compared to females. Koloverou et al¹⁵ conducted a prospective study and investigated the impact of alcohol intake

on diabetes incidence. In this cohort, the authors selected 3042; among them 1514 were men with age range 18-89 years and 1528 were women 18-87 years old. The authors found high incidence of diabetes, which was 13.4% in men and 12.4% in women. In addition, Han et al⁹ investigated the relationship between alcohol use and risk of T2DM. In this longitudinal study authors invited 12,186 (M=5617; F=6569) adults, identified the incidence of T2DM among males was 6.69% and females was 5.19%, however the total incidence among both gender was 5.48%. This study demonstrated that alcohol consumption was significantly associated with increased risk of T2DM. Similarly, in the present study, we found that the incidence of T2DM among male alcohol users was 7% and in female alcohol users was 6%. The pooled incidence of T2DM was higher in males compared to females.

Mechanism how alcohol can cause Diabetes Mellitus:

This study explain the liaison between alcohol intake and prevalence of T2DM. Although, it is hard to understand the mechanism and the risk with one another in complex ways in the development of T2DM, it may however be explained via various mechanisms. Liver is the main metabolic organ and considered as a victim of the harmful use of alcohol. Acute liver damage due to alcohol use may cause defects in glucose homeostasis and glucose control mechanism²⁹. Moreover, excessive alcohol consumption contributes to increase blood glucose by increasing "2,3-butanediol and 1,2-propanediol" which decrease the use of glucose in skeletal muscle and increase insulin resistance³⁰. Another mechanism which is also allied to develop T2DM among alcohol users that alcohol and its metabolites directly injure pancreatic acinar cells and elicit "necrosis-fibrosis" sequence that leads to atrophy, fibrosis, and chronic pancreatitis³. Alcoholics have repeatedly been found to have deregulation of the glucose metabolism by impaired insulin secretion, increased hepatic glucose production and decreased peripheral glucose utilization. The link between alcohol intake and T2DM identified in this study could be explained by these mechanisms, which are

important for the better understanding of the pathophysiological basis of these mechanisms.

Strengths and Limitations

This study added in literature established the association between alcohol intake occurrence of type 2 diabetes mellitus (T2DM) amongst male and female alcohol users. Data was collected using very dependable and consistent sources like "Medline", "Pub-Med", "Web of Science", "Scopus" and "EMBASE". However, the limitations of this study are that the authors chose the homogeneous, cohort, randomized with large sample sized community studies following the standard conditions while authors confronted few procedural challenges as in different studies numerous methodological approaches were followed to find association among alcohol intake with T2DM. The other limitations of this study are that, we were unable to classify the drinking patterns, which may complicate the estimation of the relationship between alcohol and T2DM.

Conclusion

Alcohol intake is associated with increasing occurrence of T2DM. The pervasiveness of T2DM was high among males compared to females. In spite of social, health and economic problems linked to detrimental alcohol consumption where this reality continued as a low priority in public health policies comparatively. It is suggested that a healthy lifestyle pattern should be adopted and alcohol control policies should be implemented on average and high-risk drinking patterns. Moreover, health educational awareness programs should be familiarized to highlight the hazardous effects of alcohol and its association with T2DM. Alcohol users must think before to drink.

Conflict of Interest: No conflict declared.

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References

1. World Health Organization. Alcohol: [Updated 2020] Available at: [<https://www.who.int/health-topics/alcohol>].
2. Lasebikan VO, Ayinde O, Odunleye M, Adeyefa B, Adepoju S, Fakunle S. Prevalence of alcohol consumption and alcohol use disorders among outdoor drinkers in public openplaces in Nigeria. *BMC Public Health* 2018; 18(1): 400.
3. Rocco A, Compare D, Angrisani D, Sanduzzi Zamparelli M, Nardone G. Alcoholic disease: liver and beyond. *World J Gastroenterol* 2014; 20(40):14652-9.
4. Manicone PF1, Tarli C, Mirijello A, Raffaelli L, Vassallo GA, Antonelli M, Rando MM, Mosoni C, Cossari A, Lavorgna L, Caputo F, D'Addona A, Gasbarrini A, Addolorato G. Dental health in patients affected by alcohol use disorders: a cross-sectional study. *Eur Rev Med Pharmacol Sci* 2017; 21(22): 5021-7.
5. Vassallo GA, Mirijello A, Tarli C, Rando MM, Antonelli M, Garcovich M, Zocco MA, Sestito L, Mosoni C, Dionisi T, D'Addio S, Tosoni A, Gasbarrini A, Addolorato G. Madelung's disease and acute alcoholic hepatitis: case report and review of literature. *Eur Rev Med Pharmacol Sci*. 2019; 23(14):6272-6.
6. Meo SA, Usmani AM, Qalbani E. Prevalence of type 2 diabetes in the Arab world: impact of GDP and energy consumption. *Eur Rev Med Pharmacol Sci* 2017; 21(6): 1303-12.
7. Meo SA, Memon AN, Sheikh S, Rouq FA, Usmani AM, Hassan A, Arian SA. Effect of environmental air pollution on type 2 diabetes mellitus. *Eur Rev Med Pharmacol Sci* 2015; 19(1) 123-128.
8. Meo SA, AlMutairi FJ, Alasbali MM, Alqahatani TB, AlMutairi SS, Albuhayjan RA, Al-Rouq F, Ahmed N. Mellitus. *Am J of Men's Health* 2018; 12(6): 2167-72.
9. Han T, Zhang S, Duan W, Ren X, Wei C, Sun C, Li Y. Eighteen-year alcohol consumption trajectories and their association with risk of type 2 diabetes and its related factors: the China Health and Nutrition Survey. *Diabetologia*. 2019; 62(6): 970-80.
10. Knott CS, Britton A, Bell S. Trajectories of alcohol consumption prior to the diagnosis of type 2 diabetes: a longitudinal case-cohort study. *Int J Epidemiol*. 2018; doi: 10.1093/ije/dyx274.
11. Kerr WC, Williams E, Li L, Lui CK, Ye Y, Greenfield TK, Lown EA. Alcohol use patterns and risk of diabetes onset in the 1979 National Longitudinal Survey of Youth Cohort. *Prev Med*. 2018; 109(4): 22-27.
12. Lim J, Lee JA, Cho HJ. Association of Alcohol Drinking Patterns with Presence of Impaired Fasting Glucose and Diabetes Mellitus Among South Korean Adults. *J Epidemiol*. 2018; 28(3): 117-24.
13. Peng M, Zhang J, Zeng T, Hu X, Min J, Tian S. Alcohol consumption and diabetes risk in a Chinese population: a Mendelian randomization analysis. *Addiction*. 2019 114(3):436-49.
14. Holst C, Becker U, Jørgensen ME, Grønbaek M, Tolstrup JS. Alcohol drinking patterns and risk of diabetes: a cohort study of 70,551 men and women from the general Danish population. *Diabetologia*. 2017; 60(10):1941-50.
15. Koloverou E, Panagiotakos DB, Pitsavos C, Chrysohou C, Georgousopoulou EN, Metaxa V, Stefanadis C. Effects of alcohol consumption and the metabolic syndrome on 10-year incidence of diabetes: the ATTICA study. *Diabetes Metab*. 2015; 41(2):152-9.
16. Hong SW, Linton JA, Shim JY, Kang HT. High-risk drinking is associated with a higher risk of diabetes mellitus in Korean men, 2010-2012 KNHANES. *Alcohol*. 2015; 49(3):275-81.
17. Liang W, Chikritzhs T. Alcohol consumption during adolescence and risk of diabetes in young adulthood. *Biomed Res Int*. 2014; <https://doi.org/10.1155/2014/795741>.
18. Djoussé L, Biggs ML, Mukamal KJ, Siscovick DS. Alcohol consumption and type 2 diabetes among older adults: the Cardiovascular Health Study. *Obesity*. 2007; 15(7):1758-65.
19. Waki K, Noda M, Sasaki S, Matsumura Y, Takahashi Y, Isogawa A, Ohashi Y, Kadowaki T, Tsugane S; JPHC Study Group. Alcohol consumption and other risk factors for self-reported diabetes among Middle-aged Japanese: a population-based prospective study in the JPHC study cohort I. *Diabet Med* 2005; 22(3): 323-31.
20. Kao WH, Puddey IB, Boland LL, Watson RL, Brancati FL. Alcohol consumption

and the risk of type 2 diabetes mellitus: atherosclerosis risk in communities study. *Am J Epidemiol.* 2001; 154(8):748-57.

21. International Diabetes Federation (IDF) Atlas. 9th Edition. [Updated 2019]. Available at [<https://www.diabetesatlas.org/en/sections/worldwide-toll-of-diabetes.html>]

22. Lai YJ, Hu HY, Lee YL, Ko MC, Ku PW, Yen YF. Frequency of alcohol consumption and risk of type 2 diabetes mellitus: A nationwide cohort study. *Clin Nutr.* 2019; 38(3): 1368-72.

23. Hodge AM, English DR, O'Dea K, Giles GG. Alcohol intake, consumption pattern and beverage type, and the risk of Type 2 diabetes. *Diabet Med.* 2006; 23(6): 690-7.

24. Wannamethee SG, Camargo CA Jr, Manson JE, Willett WC, Rimm EB. Alcohol drinking patterns and risk of type 2 diabetes mellitus among younger women. *Arch Intern Med.* 2003; 163(11):1329-36.

25. Baliunas DO, Taylor BJ, Irving H, Roerecke M, Patra J, Mohapatra S, Rehm J. Alcohol as a risk factor for type 2 diabetes: a systematic review and meta-analysis. *Diabetes Care.* 2009;

32(11): 2123-32.

26. Vancampfort D, Mugisha J, Hallgren M, De Hert M, Probst M, Monsieur D, Stubbs B. The prevalence of diabetes mellitus type 2 in people with alcohol use disorders: a systematic review and large scale meta-analysis. *Psychiatry Res.* 2016; 246(12):394-400.

27. Marques-Vidal P, Vollenweider P, Waeber G. Alcohol consumption and incidence of type 2 diabetes. Results from the CoLaus study. *Nutr Metab Cardiovasc Dis.* 2015; 25(1):75-84.

28. Cullmann M, Hilding A, Östenson CG. Alcohol consumption and risk of pre-diabetes and type 2 diabetes development in a Swedish population. *Diabet Med.* 2012; 29(4): 441-52.

29. Howard AA, Arnsten JH, Gourevitch MN. Effect of alcohol consumption on diabetes mellitus: a systematic review. *Ann Intern Med* 2004; 140(3):211-9.

30. Xu, Dhillon AS, Abelman A, Croft K, Peters TJ, Palmer TN. Alcohol-related diols cause acute insulin resistance in vivo. *Metabolism* 1998; 47(10): 1180-6.