JOMH Journal of Men's Health

J. Mens. Health **2022**; 18(3): 077
http://doi.org/10.31083/j.jomh1803077

Original Research

The mediating effect of quality of life on alcohol consumption and the 10-year type 2 diabetes mellitus risk score in adult Korean men

MiRan Bang[1], KyungAe Kim[1,*], JaeLan Shim[2]

[1]College of Nursing, Kyungdong University, 26495 Wonju-si, Republic of Korea
[2]College of Nursing, Dongguk University, 38066 Gyeongju-si, Republic of Korea
*Correspondence: Kimkyungae9806@gmail.com (KyungAe Kim)
Submitted: 19 August 2021 Accepted: 27 October 2021 Published: 2 March 2022

Abstract

Background: The rate of high-risk drinking, a major cause of type 2 diabetes mellitus (T2DM), is increasing among Korean men. This study descriptive survey whether quality of life (QoL) mediates the relationship between drinking and 10-year T2DM risk scores in adult Korean men. **Methods**: We further analyzed data from the 7th Korea National Health and Nutrition Examination Survey 7th (KNHANES VII) from 2016 to 2018, selecting 4134 men aged 40–69 years who were not diagnosed with T2DM. The data were analyzed using complex sample regression; after analyzing the mediation. **Results**: In step 1 of the regression, the drinking rate significantly predicted QoL ($\beta = 0.08$, $p < 0.001$), and in step 2, the drinking rate significantly predicted the 10-year T2DM risk score ($\beta = 0.08$, $p < 0.001$). In step 3, the drinking rate ($\beta = 0.08$, $p < 0.001$) and QoL ($\beta = –0.09$, $p < 0.001$) were found to significantly predict the 10-year T2DM risk score, confirming that QoL partially mediates the 10-year T2DM risk score ($z = –3.62$, $p < 0.001$). QoL was found to mediate the relationship between the drinking rate and 10-year T2DM risk score. **Conclusions**: Sex-specific risk factors must be considered to reduce the incidence of T2DM, and measures to promote healthy drinking habits need to be implemented to reduce the incidence of T2DM in men. Furthermore, these findings highlight the need to develop and actively implement various practical intervention strategies to enhance QoL.

Keywords: diabetes mellitus; alcohol consumption; quality of life; mediation analyses; men

1. Introduction

In 2019, there were approximately 463 million adults aged 20–79 years worldwide with type 2 diabetes mellitus (T2DM), and this number is expected to rise to 578 million in 2030, and 700 million in 2045 [1]. In 2018, the prevalence of T2DM in South Korea increased to one in seven adults aged 30 years or older [2]. Moreover, T2DM occurs more often in men (15.9%) than women (11.8%) (Korean Diabetes Association, 2020), highlighting the urgent need for interventions to target the specific causes of T2DM in men [2].

Risk factors associated with T2DM include obesity, reduced physical activity, increased intake of sugar-rich foods, smoking, heavy alcohol consumption, social and economic stress, and sleep disorders [3]. The blood testosterone concentration begins to drop by 1%–2% every year from the age of 40 in men, which increases the risk for T2DM [4,5]. Accordingly, T2DM prevalence increases with age in Korean men, as it reportedly afflicts 13.0%, 17.9%, and 25.7% of men in their 40s, 50s, and 60s respectively [2].

Alcohol consumption is a major risk factor for T2DM [6]. Korean and Asian men have a higher risk for T2DM than their western counterparts due to the prevalence of variants of the aldehyde dehydrogenase 2 (ALDH2) gene. In women, this gene does not affect the incidence of T2DM [7]. ALDH2 inhibits alcohol metabolism, and when expressed in individuals that frequently consume alcohol, it can increase the risk of T2DM [7]; hence multilateral studies are warranted to determine the factors associated with drinking rates in men.

The monthly drinking rate (which is calculated by dividing the number of people who have had at least one drink per month in the past year by the total number of people) of Koreans in 2017 was 74% for men and 50% for women. Furthermore, 20.8% of Korean men engaged in high-risk drinking (>7 drinks at any given time), exceeding the global average of 18.2% [8–10], which underlines the need to promote healthy drinking habits. High-risk drinking is correlated with job stress in Korean men [11,12]. Additionally, social and cultural pressures also need to be taken into account, as Korean men may be encouraged to drink alcohol by friends or colleagues and their inability to refuse alcohol in social settings may affect their drinking habits [13], which is different to the findings for other countries [14].

The social pressure placed on Korean men to consume alcohol can increase the risk of T2DM [13,15] and reduce their quality of life (QoL) [16]. Some studies have reported that high blood sugar levels and the complications and duration of T2DM can also reduce QoL; hence, early diagnosis and treatment could help to improve QoL [17,18]. Data showing the direct impact of QoL on the onset of T2DM are lacking. Furthermore, QoL is negatively correlated with al-

cohol consumption [19,20], i.e., lowering alcohol consumption has been shown to improve QoL [4]. Hence, it is important to examine the relationships among these factors to lower the incidence of T2DM attributed to high levels of alcohol consumption among Korean men.

This study examines the relationship between the drinking rate and QoL in Korean men and the impact of these factors on the estimated T2DM risk and investigates the mediating effect of QoL on the drinking behavior and the estimated 10-year risk of developing T2DM in adult Korean men. The results of this study will provide foundational data to develop intervention strategies that promote optimal drinking habits, establish a healthy drinking culture, and enhance QoL, thereby reducing the incidence of T2DM in men, and aid in the development of sex-specific lifestyle interventions, T2DM prevention programs, and help with diagnosis and treatment.

2. Materials and methods

2.1 Experimental design

This study used a descriptive survey and a secondary data analysis of raw data from the seventh Korea National Health and Nutrition Examination Survey, to examine the mediating effects of QoL on the relationship between drinking rate and the 10-year risk of T2DM in adult Korean men.

2.2 Participants

The KNHANES VII (2016–2018) raw data were obtained from the Korea Disease Control and Prevention Agency (KDCA), an affiliated organization of the Ministry of Health and Welfare. The survey used stratified two-stage cluster sampling, in which sample households were selected from 13,248 households in 576 enumeration districts nationwide in two stages. The sampling framework was stratified based on city/province, neighborhood/town/township (dong/eup/myeon), and house (single house, apartment). Factors such as living space ratio and education of the head of the household were criteria for implicit stratification.

Of the 24,269 participants in the survey, 10,586 adults aged 40–69 years were first extracted. Next, 972 participants who had been diagnosed with T2DM or were undergoing pharmacological therapy were excluded, resulting in a total of 9614 adults. Finally, 5480 women were excluded, resulting in 4134 men who were included in this study (Fig. 1).

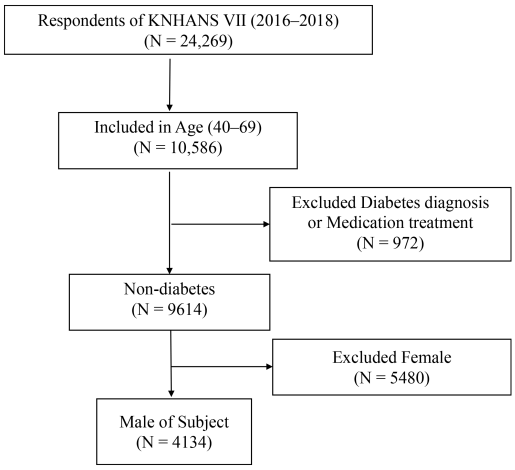

Fig. 1. Flow chart of the study population.

2.3 Study variables

2.3.1 Sociodemographic characteristics

Sociodemographic and health-related characteristics such as age, family, living situation, and perceived health were surveyed. For central obesity, the waist-to-height ratio (WHtR) was calculated using waist circumference and height, and the participants were classified based on the Asian cutoff for cardiovascular risk (0.53) [21]. Low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides, glycated or glycosylated hemoglobin (HbA1c), blood sugar, and high-sensitivity C-reactive protein (hs-CRP) levels were obtained from laboratory results.

2.3.2 Monthly alcohol consumption

The monthly drinking rate was defined as the percentage of participants who have had at least one drink per month in the past year. The value is calculated from the raw data by dividing the number of participants who stated that they had had at least one drink per month in the past year by the total number of participants. High-risk drinking was defined as drinking twice or more per week, with an average of seven or more drinks per sitting. In the present study, drinking frequency in the past year was classified as abstinent, low ($<$1 drink/month to 2–4 drinks/month), and high ($\geq$2 drinks/week) [22,23].

2.3.3 Quality of life

QoL was measured using the EuroQol-5Dimension (EQ-5D) developed by the EuroQol Group (www.euroqol.org). The EQ-5D comprises five subscales: mobility (M), self-care (SC), usual activity (UA), pain/discomfort (PD), and anxiety/depression (AD), and the current state of each of these factors is rated using a three-option scale as follows: “no problem at all (1)”, “some problems (2)”, and “serious problems (3)”.

In this study, the EQ-5D index for each of the five subscales was computed using the following conversion formula that applies weighting for the Korean population: The EQ-5D Index ranges from –1 (worst health) to 1 (perfect health), where a higher index indicates a higher QoL [24].

$$\begin{aligned} \text{EQ} - 5\text{D} = 1 - (&0.05 + 0.096 \times \text{M2} + 0.418 \times \text{M3} \\ &+0.046 \times \text{SC2} + 0.136 \times \text{SC3} + 0.051 \times \text{UA2} + 0.208 \\ &\times \text{UA3} + 0.037 \times \text{PD2} + 0.151 \times \text{PD3} + 0.043 \\ &\times \text{AD2} + 0.158 \times \text{AD3} + 0.05 \times \text{N3}) \end{aligned}$$

2.3.4 10-year T2DM risk

The risk score for developing T2DM after 10 years was calculated using an equation to predict the risk of developing diabetes in Korea that was developed by Ha *et al*. [23]. The equation predicted the diabetes risk by applying the Cox proportional risk regression model using the National Health Insurance Corporation-National Health Checkup Cohort (NHIS-HEALS) [23,25]. The analysis included the following variables that are known to influence diabetes risk: age, family history of diabetes, alcohol intake, smoking status, physical activity, antihypertensive therapy, statin therapy, body mass index (BMI), systolic blood pressure (SBP), total cholesterol, and fasting blood glucose. BMI was classified according to Asian-specific criteria based on the World Health Organization Western Pacific Region [26] as follows: underweight ($<$18.5 kg/m^2), normal weight (18.5–22.9 kg/m^2), overweight (23.0–24.9 kg/m^2), obese class I (25.0–29.9 kg/m^2), and obese class II ($\geq$30.0 kg/m^2).

In this study, according to Ha *et al*. [23], the variables used were first stratified and classified. Then coefficient values according to the stratified items were substituted. After the coefficient value for each variable was calculated, the total was calculated. The total number of variables was divided by the total score, to yield a risk score for developing T2DM after 10 years. The final value was obtained by making a calculation formula so that the subjects' risk of diabetes could be calculated statistically.

2.4 Data collection

The KNHANES VII was conducted from January 1, 2016, to December 31, 2018, and the health surveys and examinations were performed in a mobile examination center. The health survey comprised a self-report questionnaire for health behaviors, including smoking status and drinking status, and an interview regarding medical history and medications. The examination consisted of anthropometry, observation, and sample analysis. Participants fasted for $>$8 hours before having their blood sampled. The professional surveyors were nurses, nutritionists, and public health majors, who were trained for 2–4 weeks before conducting the surveys. The surveyors' survey performance is managed through mandatory refresher training (7 times a year) and field quality control.

2.5 Statistical analysis

The collected data were analyzed using the SPSS version 23.0 (IBM SPSS Statistics, Chicago, IL, USA). The KNHANES used stratified two-stage cluster sampling, and following the analysis guidelines for the raw data, we used a complex sample analysis. As complex sample data, each variable had a missing value, so the subject was different for each variable. Missing values were replaced with significant values for the analysis of each variable. The general characteristics of adult Korean men and factors associated with the 10-year T2DM risk score were analyzed using the *t*-test or χ^2 test. Furthermore, the mediating effect of QoL on the relationship between drinking rate and 10-year T2DM risk in adult men was analyzed using the three-step regression by Baron and Kenny [27]. The mediating effect of QoL and its significance were tested using the Sobel test (http://www.quantpsy.org/sobel/sobel.htm) with the calculated regression coefficient and standard error. Statistical significance was set at $p < 0.05$.

3. Results

3.1 Patient characteristics

A total of 4134 participants were included in our analysis, with a mean age of 52.39 $\pm$ 0.15 years. Of the participants, 12.6% perceived themselves as having poor health. The monthly drinking rate was 0.74 $\pm$ 0.01, and the mean QoL score was 0.970. A total of 33.1% of the participants had a WHtR of 0.53 or higher. The laboratory results were as follows: 69.6% had LDL $\geq$100 mg/dL, 64.0% had HDL $<$50 mg/dL, 44.6% had triglycerides $\geq$150 mg/dL, 34.4% had an HbA1c of 5.7–6.4%, and the mean hs-CRP level was 1.23 $\pm$ 0.03 (Table 1).

3.2 Ten-year T2DM risk score of adult Korean men

Of all the participants, 23.4% had a family history of T2DM, and alcohol consumption rates were abstinent (15.3%), low (44.4%) and high (40.3%). A total of 37.8% of the participants were current smokers, and 24.7% claimed to engage in moderate-intensity physical activity. Of the participants, 20.1% were currently undergoing antihypertensive therapy, while 9.3% were currently undergoing statin therapy. A total of 43.4% of the participants had a BMI of $\geq$25.0 kg/m^2. The mean 10-year T2DM risk score was 19.81% (Table 2).

3.3 QoL mediates the relationship between drinking rate and the 10-year T2DM risk

The three-step regression proposed by Baron and Kenny [27] was performed to analyze the mediating effect of QoL on the relationship between drinking rate and the 10-year T2DM risk. In step 1, the drinking rate (independent variable) had a significant effect on QoL (mediator) (β = 0.08, $p < 0.001$). In step 2, the drinking rate had a significant effect on the 10-year T2DM risk (dependent variable) (β = 0.08, $p < 0.001$). In step 3, the drinking rate (β = 0.08, $p < 0.001$) and QoL (β = –0.09, $p < 0.001$) significantly influenced the 10-year T2DM risk. In this step, the effect of the drinking rate on the 10-year T2DM risk remained statistically significant even after entering the mediator (QoL), confirming that QoL has partial mediation (Fig. 2). The Sobel test was performed to test the statistical significance of the partial mediation of QoL on the relationship between the drinking rate and 10-year T2DM risk, and the results confirmed that the partial mediating effect of QoL was significant (z = –3.62, $p < 0.001$) (Table 3).

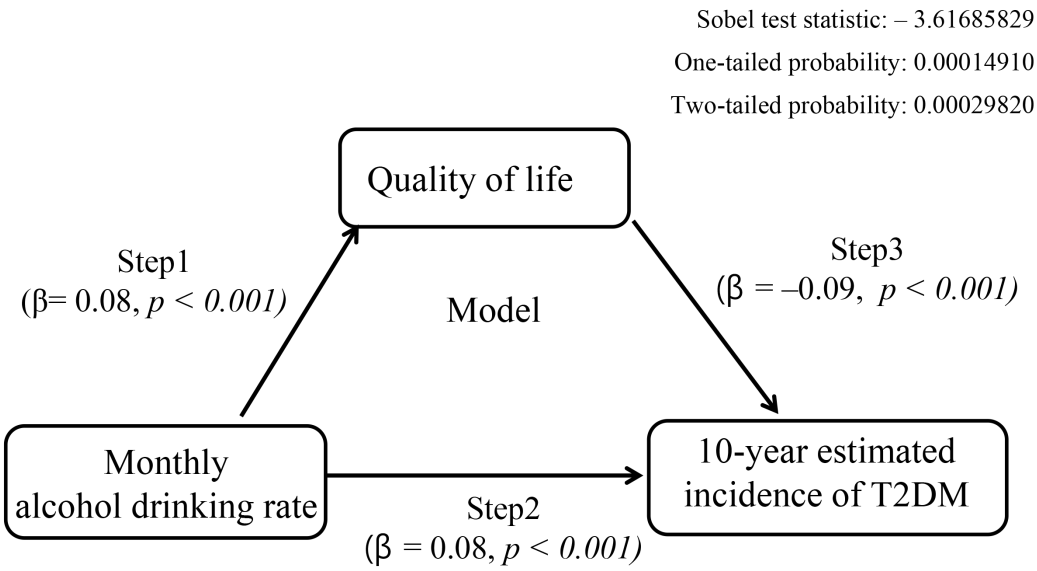

Fig. 2. Mediating effect of quality of life on 10-year estimated incidence of T2DM in Korean adult males.

4. Discussion

Among adult Korean men, high-risk drinking rates and the incidence of T2DM are both increasing, therefore, confirming that the drinking rate and QoL of adult men could predict the 10-year T2DM risk. This study suggests that strategies to lower drinking rates and improve QoL are required to lower the prevalence of T2DM within 10 years in men.

Our results confirmed that both the drinking rate and QoL were predictors of the 10-year T2DM risk in men, as when QoL decreased the 10-year T2DM risk scores and drinking rate increased. Furthermore, QoL was found to partially mediate the relationship between the drinking rate and 10-year T2DM risk. These results are consistent with the results of a Danish cohort study in which the incidence of T2DM was relatively higher among those who drank 14 drinks per week when compared to those who consumed no alcohol [28]. This study supported the results of an epidemiological survey that involved a 10-year follow-up cohort study of 39,259 Chinese adults aged 18 to 79 years. In this study, the incidence of diabetes increased in line with alcohol consumption, and those who did not drink alcohol for 10 years showed no association with the occurrence of 2TDM [29]. The 2010–2011 KNHANES data for adults aged 40 years or older showed that excessive alcohol consumption is associated with a lower QoL than moderate and no alcohol consumption, which supports our findings [16]. In contrast to foreign drinking cultures, Korean drinking culture involves heavy drinking for reasons such as fostering friendship, resolving interpersonal problems, and relieving stress [30]. A study on working men in Korea reported that men frequently experience extended work hours, stress at work, and frequent group dinners at work. Furthermore, Korean workers find it difficult to manage their stress and engaging in self-care; as 52.9% of workers drink heavily, 86.2% do not exercise, and 31.3% smoke [31], suggesting that the unhealthy drinking culture has society-wide effects. In addition, Koreans are more lenient towards the consumption of alcohol and high-calorie foods than their foreign counterparts [32]. Such excessive alcohol consumption is a risk factor for T2DM and may induce or exacerbate T2DM [33,34]. According to the 2019 Liquor Market Trend Report in Korea, Korean adults prefer mixed beers and soju drinks (69.8%). Soju contains 18–24% alcohol and therefore must be consumed with precaution [35].

Previous studies have reported that drinking and the risk for T2DM and its complications demonstrated a U-shaped relationship, where moderate drinking lowers the risk for T2DM and facilitates better metabolic regulation [6,19]. However, such benefits of drinking may differ based on age, sex, BMI, ethnicity, and type of alcohol [6].

One study has reported that one- or two-level reductions in the WHO risk drinking substantially improved physical health and QoL in 1142 individuals with alcohol dependence (68.8% men, 32.2% women) [4], illustrating the benefits of moderate alcohol consumption. Our results support previous findings that excessive alcohol consumption diminishes QoL [16,19,20]. In a study of 1594 participants in the United States, it was shown that moderate drinking increased the QoL of the adults [36], showing contradictory results to the results of this study. The results of this study did not correct for the occurrence of diseases, so it is difficult to generalize. In Helsinki's cohort study of 5301 women and 1230 men, excessive alcohol consumption was found to affect mental functioning and QoL [37]. Furthermore, 4592 participants in a 2.3-year follow-up study in Hong Kong, showed that drinking had an effect on mental well-being, indicating that caution is required when making

Table 1. Characteristics of the participants (N = 4134).

Variables	n (%) †	M ± SE
Age (years)		52.39 ± 0.15
Living with		
Spouse or children	3748 (91.1)	
Divorced/unmarried	386 (8.9)	
Perceived health status		
Good	1169 (30.5)	
Moderate	2457 (56.9)	
Poor	508 (12.6)	
Monthly alcohol drinking rate ‡		0.74 ± 0.01
Quality of life (EQ-5D score)		0.97 ± 0.00
WHtR		0.51 ± 0.00
<0.53	2312 (66.9)	
≥0.53	1244 (33.1)	
Low-density lipoprotein (mg/dL) §		117.73 ± 1.23
<100	308 (29.8)	
≥100	703 (70.2)	
High-density lipoprotein (mg/dL)		47.06 ± 0.21
<50	2409 (64.0)	
≥50	1366 (36.0)	
Triglyceride (mg/dL)		181.64 ± 3.60
<150	2147 (55.4)	
≥150	1673 (44.6)	
HbA1c (%)		5.65 ± 0.01
≤5.6	2320 (65.6)	
5.7–6.4	1286 (34.4)	
high C-reactive protein		1.23 ± 0.03

N, unweighted count; %, weighted count; SE, standard error; EQ-5D, Euro Quality of Life - 5 Dimensions; WHtR, waist-to-height ratio; HbA1c, glycated hemoglobin.

† Missing values were dealed with multiple imputation.

‡ This variable was calculated by including all subjects as the denominator and the number of subjects who drank alcohol at least once a month last year as the numerator (N = 4134).

§ Log GGT is a variable that applies only to women (N = 4134).

recommendations regarding moderate alcohol intake [38]. Therefore, it is necessary to study various aspects of the relationship between the quantity and frequency of drinking intake and the quality of life.

In this study, the 10-year T2DM risk increased with a decrease in QoL, which supports earlier findings that patients diagnosed with T2DM have a five-fold reduced QoL score when compared to their healthy counterparts [39] and that QoL significantly differs between the T2DM and normal groups [40], which is in line with our results. However, the participants in this study were limited to those without T2DM, while previous studies have mostly examined QoL in patients with T2DM. Cohort studies should thus be conducted to better investigate the effects of QoL on drinking rate and the incidence of T2DM. It has been reported that sensible drinking, i.e., fewer than two drinks per day, in men [41] is associated with a higher QoL and lower incidence of T2DM [42], suggesting that measures to promote an awareness of healthy alcohol drinking habits are warranted to improve QoL and decrease the incidence of T2DM.

In this study, 34.1% of the participants had a 10-year T2DM risk of 20% or higher. The high-risk drinking rate was 40.3%, highlighting the urgency of planned intervention strategies that restrict high-risk drinking and establish healthy drinking habits. However, QoL was identified as a predictor of drinking rate; hence, measures to reduce the drinking rate should focus on improving the QoL, to ultimately reduce the incidence of T2DM in men.

This study has several limitations. First, the data for lifestyle and medications were collected using a self-report questionnaire. As the responses were dependent on the participants' recall, they may differ from the actual values. Subsequently, cohort studies covering a longer study period for the incidence of T2DM in men are needed. Second, the KNHANES is a cross-sectional survey that focuses on understanding the relationships among the variables. This hinders the establishment of causality between the 10-year T2DM risk and other independent variables. Third, the discussion of the results of this study is limited due to the lack of epidemiologic studies on QoL as a factor influencing the predictive score of 2TDM occurrence after 10 years in men. Therefore, it is suggested that an expanded study should be conducted to confirm the effect on QoL and the occurrence of diabetes in subjects without diabetes mellitus. Thus, we suggest that longitudinal studies that implement interventions for drinking habits and examine the prevalence of T2DM should be conducted.

Despite these limitations, this study makes notable contributions as we have confirmed that QoL is a partial mediator in the relationship between drinking and 10-year T2DM risk in Korean men, using nationally representative data for the Korean people's health and nutritional status. The results of this study highlight the need to implement sex-specific approaches to lower the incidence of T2DM. Our findings provide new insights for the design of intervention programs to lower the prevalence of T2DM by exploring measures to enhance QoL in men.

Furthermore, to lower the incidence of diabetes in middle-aged men, policy control on alcohol marketing to lower the drinking rate, which affects QoL and socio-cultural changes, is necessary to specifically lower the frequency and intensity of alcohol consumption.

These changes must first change the public perception of harmful drinking through active publicity via the TV, internet, and social networks to improve good drinking habits. In addition, the socio-cultural habits that promote high levels of drinking due to stress at work also need to be changed. To this end, measures to reduce job stress through efficient work management should be sought. In addition, changes

Table 2. Ten-year estimated incidence of type 2 diabetes mellitus in adult male Korean subjects (N = 4134).

Variables	n (%) [†]	M ± SE
Age (years)		
40–49	1519 (41.6)	
50–59	1423 (37.1)	
60–69	1192 (21.3)	
Family history of diabetes		
Yes	875 (23.4)	
No	3259 (76.6)	
Alcohol intake		
Abstinent	629 (15.3)	
Low	1707 (44.4)	
High	1566 (40.3)	
Smoking status		
Non-smoker	740 (18.7)	
Former smoker	1736 (43.5)	
Current smoker	1426 (37.8)	
Physical activity (MET-min/week)		
Low (<600)	2241 (51.6)	
Medium (600–1499)	964 (24.7)	
High (≥1500)	929 (23.7)	
Antihypertensive therapy		
Yes	845 (20.1)	
No	3289 (79.9)	
Statin therapy		
Yes	405 (9.3)	
No	3729 (90.7)	
Body mass index (kg/m^2) [‡]		24.55 ± 0.05
<18.5	68 (1.7)	
18.5–22.9	1062 (27.9)	
23.0–24.9	1036 (27.0)	
25.0–29.9	1483 (39.0)	
≥30.0	158 (4.4)	
Systolic BP (mm Hg)		121.21 ± 0.31
Total cholesterol (mg/dL)		198.77 ± 0.73
Fasting glucose (mg/dL)		102.48 ± 0.41
Log GGT [§]	NA	
Estimated score of diabetes incidence after 10 years (%)		19.81 ± 0.27
<11	1449 (35.5)	
11–20	1160 (30.4)	
21–30	587 (15.2)	
>30	786 (18.9)	

N, unweighted count; %, weighted count; SE, standard error; MET, metabolic equivalent of task; BP, blood pressure; GGT, γ-glutamyl transferase; NA, not applicable.

[†] Missing values were dealed with multiple imputation.

[‡] BMI was classified according to the World Health Organization Western Pacific Region.

[§] For LDL subjects, only those with a triglyceride level of 200 mg/dL or higher were measured from 2016 to 2018, and there is a difference in the number of respondents.

Table 3. Mediating effect of quality of life on the 10-year estimated incidence of T2DM in adult male Korean subjects.

Causal steps	B	β	F	p
Step 1. Monthly alcohol drinking rate[†] → Quality of life	0.01	0.08	21.34	<0.001*
Step 2. Monthly alcohol drinking rate → 10-year estimated incidence of T2DM	2.81	0.08	27.19	<0.001
Step 3.			29.80	<0.001
(1) Monthly alcohol drinking rate → 10-year estimated incidence of T2DM	2.81	0.08	27.19	<0.001
(2) Quality of life → 10-year estimated incidence of T2DM	17.40	−0.09	29.80	<0.001

B, unstandardized regression coefficient; β, standardized regression coefficient; T2DM, type 2 diabetes mellitus.

[†] This variable was calculated by including all the subjects as the denominator and the number of subjects who responded that they drank alcohol at least once a month last year as the numerator; *$p < 0.05$ (N = 4134).

in workplace culture and improvement of company managers' awareness and policies should be established.

Medical staff believe that multidisciplinary cooperation is required to actively improve behavioral therapy and lifestyle to reduce risk factors for middle-aged men who have increased ten-year risk scores for the incidence of diabetes.

5. Conclusions

We investigated the effects of QoL on the relationship between drinking rate and the 10-year T2DM risk in Korean men aged 40–64 years. The drinking rate and QoL were identified as predictors of the 10-year T2DM risk. QoL decreased as the drinking rate increased and had a partial mediating effect on the relationship between drinking and the 10-year T2DM risk. Furthermore, the 10-year T2DM risk increased with the decreasing QoL and increasing drinking rate. Therefore, to lower the incidence of T2DM in Korean men, healthy alcohol consumption habits must be promoted, and continuous educational interventions are required. Moreover, lifestyle modification approaches, which influence the drinking rate, should be tailored to each sex, and active education and promotion, and practical intervention strategies are urgently needed. The findings of this study will contribute to the development of individualized T2DM prevention programs and increase the awareness of the risk factors for diabetes in men.

Abbreviations

BMI, Body mass index; DM, Diabetes mellitus; HDL, High-density lipoprotein; IRB, Institutional Review Board; KDCA, Korea Disease Control and Prevention Agency; LDL, Low-density lipoprotein; QoL, Quality of life; SB, Systolic blood pressure.

Author contributions

MRB, KAK, and JLS conceived and designed the experiments. MRB analyzed the data. MRB, KAK, and JLS wrote and approved the final manuscript for submission.

Ethics approval and consent to participate

The KNHANES VII is a survey and examination of public health behaviors, prevalence of chronic diseases, and food and nutritional intake stipulated by Article 16 of the National Health Promotion Act, and it contains government-designated statistics grounded in Article 17 of the Statistics Act. The KDCA provides only de-identified data in compliance with the Personal Information Protection Act and Statistics Act, and the survey was conducted with approval from the Korea Centers for Disease Control and Prevention Research Ethics Review Committee (2018-01-03-P-A). We downloaded the raw data after reading the "Rules on the raw data disclosure by the KCDC" from the KNHANES website (https://knhanes.cdc.go.kr/) and used the data after reading the "User guidelines for the KNHANES" and "Analysis guidelines for the KNHANES raw data". In addition, we obtained approval for secondary data analysis from the Institutional Review Board (IRB) of our affiliated university (IRB: 1041455-202106-HR-006-01).

Acknowledgment

We would like to thank Dae-Jung Kim and Kyung-Wha Ha at the Department of Endocrinology and Metabolism at Ajou University Medical Center, for sharing the results of the 10-year diabetes mellitus risk score study. We would also like to thank Eunsun Jang for providing statistical advice and assistance.

Funding

This research was supported by the Kyungdong University Research Fund, 2021, and the National Research Foundation of Korea (grant number NRF-2020R1G1A1013553).

Conflict of interest

The authors declare no conflict of interest.

References

[1] International Diabetes Federation. IDF Diabetes atlas 9th edition 2019. 2019. Available at: https://www.diabetesatlas.org/en/sections/worldwide-toll-of-diabetes.html (Accessed: 23 April 2021).

[2] Korean Diabetes Association. Diabetes Fact Sheet in Korea 2020. 2020. Available at: https://www.diabetes.or.kr/pro/news/admin.php?category=A&code=admin&number=1992&mode=view (Accessed: 23 April 2021).

[3] Kautzky-Willer A, Harreiter J, Pacini G. Sex and Gender Differences in Risk, Pathophysiology and Complications of Type 2 Diabetes Mellitus. Endocrine Reviews. 2016; 37: 278–316.
[4] Witkiewitz K, Kranzler HR, Hallgren KA, O'Malley SS, Falk DE, Litten RZ, *et al*. Drinking Risk Level Reductions Associated with Improvements in Physical Health and Quality of Life among Individuals with Alcohol Use Disorder. Alcoholism: Clinical and Experimental Research. 2018; 42: 2453–2465.
[5] Diabetes in men versus women. 2019. Available at: https://www.news-medical.net/health/Diabetes-in-Men-versus-Women.aspx (Accessed: 26 February 2019).
[6] Volaco A. Alcohol Consumption and its Relationship to Diabetes Mellitus: Friend or Foe. Endocrinology and Metabolism International Journal. 2018; 6: 00150.
[7] Spracklen CN, Horikoshi M, Kim YJ, *et al*. Identification of type 2 diabetes loci in 433,540 East Asian individuals. Nature. 2020; 582: 240–245.
[8] Korea Centers for Disease Control and Prevention. 2019 National Health Statistics. Drinking and smoking status. Available at: https://www.kdca.go.kr/upload_comm/syview/doc.html?fn=157615244957000.pdf&rs=/upload_comm/docu/0034/ (Accessed: 4 April 2021).
[9] Korean Statistical Information Service. Trend of high-risk drinking rate. Available at: https://kosis.kr/statHtml/statHtml.do?orgId=177&tblId=DT_11702_N018&vw_cd=&list_id=&scrId=&seqNo=&lang_mode=ko&obj_var_id=&itm_id=&conn_path=E1&docId=0243534434&markType=S&itmNm (Accessed: 24 April 2021).
[10] World Health Organization. Global status report on alcohol and health 2018. 2018. Available at: https://www.who.int/health-topics/alcohol#tab=tab_1 (Accessed: 30 June 2021).
[11] Jekarl J, Kim KK, Lee JT. Structural relationship between drinker's characteristics, work environment, and alcohol problems among employee. Health and Social Science. 2010; 28: 5–31.
[12] Park JH, Lee MK, Jang YE. A study on the effect of job stress of employees to depression: moderating effect of quantities and frequencies of dringking. Journal of Korean Alcohol Science. 2010; 11: 1–14.
[13] Ha Y, Jung M. Factors associated with Problem Drinking in Korean Male Employees for Drinking Motivation, Job Stress, and Drinking Refusal Self-efficacy. Korean Journal of Occupational Health Nursing. 2015; 24: 48–56.
[14] Bloomfield KIM, Grittner U, Kramer S, *et al*. Social inequalities in alcohol consumption and alcohol-related problems in the study countries of the EU concerted action 'Gender, Culture and Alcohol Problems: a Multi-national Study'. Alcohol and Alcoholism. 2006; 41: i26–i36.
[15] Cha B. A Path Analysis of Factors Influencing Health-related Quality of Life among Male Adults. Journal of Korean Academy of Community Health Nursing. 2016; 27: 399–409.
[16] Kim KH, Kim JS. The association between alcohol consumption patterns and health-related quality of life in a nationally representative sample of South Korean adults. PLoS ONE. 2015; 10: e0119245.
[17] Gebremedhin T, Workicho A, Angaw DA. Health-related quality of life and its associated factors among adult patients with type II diabetes attending Mizan Tepi University Teaching Hospital, Southwest Ethiopia. BMJ Open Diabetes Research and Care. 2019; 7: e000577.
[18] Trikkalinou A, Papazafiropoulou AK, Melidonis A. Type 2 diabetes and quality of life. World Journal of Diabetes. 2017; 8: 120.
[19] Li X, Yu F, Zhou Y, He J. Association between alcohol consumption and the risk of incident type 2 diabetes: a systematic review and dose-response meta-analysis. The American Journal of Clinical Nutrition. 2016; 103: 818–829.
[20] HEALTH NEWS. Drinking less might be tied to higher quality of life. 2019. Available at: https://www.reuters.com/news/health/article/us-health-alcohol-qol/drinking-less-might-be-tied-to-higher-quality-of-life-idUSKCN1U32KO (Accessed: 9 July 2019).
[21] Jia AH, Xu SY, Ming J, *et al*. The optimal cutoff value of waist-to-height ratio in Chinese: based on cardiovascular risk and metabolic disease. Zhonghua nei ke za zhi. 2017; 56: 822–826. (In Chinese)
[22] Korea Centers for Disease Control and Prevention. 2018 Korean National Health and Nutrition Examination Survey. 2018. Available at: https://knhanes.kdca.go.kr/knhanes/sub03/sub03_01.do (Accessed: 29 September 2021).
[23] Ha KH, Lee Y, Song SO, Lee J, Kim DW, Cho K, *et al*. Development and Validation of the Korean Diabetes Risk Score: a 10-Year National Cohort Study. Diabetes and Metabolism Journal. 2018; 42: 402–414.
[24] Nam HS, Kim KY, Kwon SS, *et al*. EQ-5D Korean valuation study using time trade off method. Seoul: Korea Centers for Disease Control and Prevention. 2007.
[25] Seong SC, Kim Y, Park SK, Khang YH, Kim HC, Park JH, *et al*. Cohort profile: the National Health Insurance Service-National Health Screening Cohort (NHIS-HEALS) in Korea. BMJ Open. 2017; 7: e016640.
[26] World Health Organization. The Asia Pacific perspective: redefining obesity and its treatment. Sydney: Health Communications. 2000; 15–21.
[27] Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of personality and social psychology. 1986; 51: 1173.
[28] Holst C, Becker U, Jørgensen ME, Grønbæk 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: 1941–1950.
[29] Wu X, Liu X, Liao W, Kang N, Dong X, Abdulai T, *et al*. Prevalence and characteristics of alcohol consumption and risk of type 2 diabetes mellitus in rural China. BMC Public Health. 2021; 21: 1–10.
[30] Cho B, Sohn A, Kim M, Yang J, Son S. Determinants of Drinking and Harmful Drinking Experience among Korean Adults. Journal of Korean Alcohol Science. 2018; 19: 1–14.
[31] Myong JP, Kim HR, Choi WS, Jo SE, Lee B, Koo JW, *et al*. The Relation between Employees' Lifestyle and their Health Status in an Electronics Research and Development Company. Korean Journal of Occupational and Environmental Medicine. 2009; 21: 1–9.
[32] Chung IB, Chang NS. Effects of alcohol drinking frequency and foods consumed along with alcohol on anthropometry, serum lipid levels, and blood pressure in male patients with type 2 diabetes mellitus. Journal of Nutrition and Health. 2008; 41: 317–326.
[33] van de Wiel A. Diabetes mellitus and alcohol. Diabetes/Metabolism Research and Reviews. 2004; 20: 263–267.
[34] Baliunas DO, Taylor BJ, Irving H, Roerecke M, Patra J, Mohapatra S, *et al*. Alcohol as a Risk Factor for Type 2 Diabetes: a systematic review and meta-analysis. Diabetes Care. 2009; 32: 2123–2132.
[35] Food Information Statistics System. 2019 Liquor Market Trend Report. Available at: https://www.atfis.or.kr/article/M001040000/view.do?articleId=3543&page=&searchKey=&searchString=&searchCategory= (Accessed: 20 June 2021).
[36] Chan AM, von Mühlen D, Kritz-Silverstein D, Barrett-Connor E. Regular alcohol consumption is associated with increasing quality of life and mood in older men and women: the Rancho

Bernardo Study. Maturitas. 2009; 62: 294–300.
[37] Salonsalmi A, Rahkonen O, Lahelma E, Laaksonen M. The association between alcohol drinking and self-reported mental and physical functioning: a prospective cohort study among City of Helsinki employees. BMJ Open. 2017; 7: e014368.
[38] Yao XI, Ni MY, Cheung F, Wu JT, Schooling CM, Leung GM, *et al*. Change in moderate alcohol consumption and quality of life: evidence from 2 population-based cohorts. Canadian Medical Association Journal. 2019; 191: E753–E760.
[39] Feng X, Astell-Burt T. Impact of a type 2 diabetes diagnosis on mental health, quality of life, and social contacts: a longitudinal study. BMJ Open Diabetes Research and Care. 2017; 5: e000198.
[40] Lu Y, Wang N, Chen Y, Nie X, Li Q, Han B, *et al*. Health-related quality of life in type-2 diabetes patients: a cross-sectional study in East China. BMC Endocrine Disorders. 2017; 17: 1–7.
[41] Centers for Disease Control and Prevention. Alcohol and public health. Available at: https://www.cdc.gov/alcohol/fact-sheets/moderate-drinking.htm (Accessed: 29 December 2020).
[42] Aschalew AY, Yitayal M, Minyihun A. Health-related quality of life and associated factors among patients with diabetes mellitus at the University of Gondar referral hospital. Health and Quality of Life Outcomes. 2020; 18: 1–8.