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Relationship between light-to-moderate alcohol consumption, serum cholesterol level, and dementia among community-living older adults aged ≥65 years in Tianjin, China

Abstract

Objective: To investigate the association between light-to-moderate alcohol consumption, serum cholesterol levels, and dementia incidence among community-dwelling older adults in Tianjin. **Methods:** A cross-sectional study of 3536 community-dwelling elderly (aged ≥65 years) in Tianjin from April to June 2019. Dementia was diagnosed using the International Classification of Diseases, 10th reversion (ICD-10). The study population was analyzed for cognitive function, serum cholesterol levels, sociodemographic information, alcohol consumption and smoking status. The correlation between these factors and the incidence of dementia were analyzed. **Results:** Light-to-moderate alcohol consumption combined with the lowest TG quartile (Q1) was identified as a protective factor against dementia. High TG levels were positively associated with dementia incidence, and this association demonstrated a significant linear trend. **Conclusion:** Light-to-moderate alcohol consumption might be associated with a lower incidence of dementia in the elderly, while high TG levels might be associated with an increased incidence. The combination of light-to-moderate alcohol consumption and low TG levels (Q1) was associated with the lowest dementia incidence.

Keywords: Dementia; Alcohol drinking; Triglycerides; Elderly.

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Introduction

With the acceleration of China's population aging process, the number of people aged ≥65 years has increased significantly, and the prevalence of dementia among this population has increased accordingly. Currently, more than 55 million people worldwide are living with dementia [1], with the corresponding rising burdens on public health and families. In 2023, the total costs for health care, long-term care, and hospice services for people aged ≥65 years with dementia were estimated at US$345 billion [2]. Therefore, strategies are needed to reduce dementia morbidity and delay cognitive decline [3].

Literature on early interventions for dementia suggests that a healthy lifestyle may contribute to maintaining cognitive health [4]. Such healthy lifestyle factors include social activities, light-to-moderate alcohol consumption, and occupational engagement. However, while some studies have reported potential positive effects of light-to-moderate alcohol consumption on cognitive function in adults [5], others have suggested that any level of alcohol consumption may increase the risk of dementia [6].

In addition, cholesterol metabolism and statins have been shown to have therapeutic effects on dementia [7]; thus, serum cholesterol levels may be related to dementia. Furthermore, alcohol directly or indirectly affects many aspects of hepatic metabolism, ultimately leading to lipid accumulation and promoting triglyceride accumulation in liver cells [8]. Notably, light-to-moderate alcohol consumption has been associated with decreased triglyceride levels. Although studies on plasma triglyceride concentrations and the risk of Alzheimer's disease are limited and inconclusive [9], Northeastward et al. [10], reported a paradoxical association where low plasma triglyceride concentrations were associated with a high risk of Alzheimer's disease; however, this finding might be attributable to reverse causation, and the relationship between triglyceride levels and Alzheimer's disease risk remains unclear.

Therefore, the present study investigated the relationship between alcohol consumption and dementia in community-dwelling older adults aged ≥65 years and explored its specific mechanism in relation to blood lipid levels.

Methods

Study setting and sampling: This cross-sectional study was conducted in rural areas of Jixian County, Tianjin, China, between April and June. Using a cluster sampling method, 106 primary healthcare institutions were selected from 949 villages. Residents aged ≥65 years who had resided locally for ≥5 years were screened for eligibility based on birthdates documented in household registration certificates. Both dementia patients and cognitively normal individuals were included. Each village health center had 1-2 fixed medical staff familiar with residents' health status.

The door-to-door survey occurred in two phases. All interviewers and diagnosticians received standardized training on data collection, neuropsychological assessment, and dementia diagnosis using ICD-10 criteria with refresher training every two months. Among 4013 eligible participants, exclusions comprised: 55 unable to complete cognitive assessment, 5 outside age range (1 aged <50 years and 4 aged 60-64 years), 2 unable to undergo lipid testing, 415 with incomplete/invalid data. Thus, 3536 participants were included (353 dementia cases; 3183 controls). None of the patients included in this study had taken any lipid-lowering drugs. In terms of antihypertensive treatment, a majority of the patients (52.48%) took antihypertensive drugs regularly, among which the commonly used types included reserpine, angiotensin receptor antagonists, and calcium channel blockers.

Dementia was clinically confirmed by trained physicians using ICD-10. Controls were defined as those scoring ≥24 on MMSE (indicating normal cognition). Participants with severe mental illness that precluded survey completion or who declined participation were excluded.

This study protocol was approved by the Medical Ethics Committee of Tianjin Medical University (Approval ID: 2019-40).

Assessment of various factors

Assessment of dementia: In the current study, dementia was diagnosed according to the International Classification of Diseases, 10th Revision (ICD-10) [11]. The diagnosis requires the presence of the following symptoms, which cannot be attributed to other major psychiatric disorders: (1) decline in memory and other cognitive functions; (2) sufficiently preserved consciousness to enable awareness of memory decline; (3) significant decline in emotional control, motivation, or social interaction; and (4) symptom duration exceeding 6 months.

Mini-mental state examination. To screen for the level of cognitive function and assist in the diagnosis of dementia, we used the MMSE [12]. This 30-item scale rapidly assesses participants' cognitive function, including memory, orientation, attention, numeracy, language ability, and visuospatial ability. Each correctly answered item scores 1 point (incorrect/unanswered: 0 points) with the total score being the sum of all items (range:0-30). Based on education-adjusted cutoffs, a total score <17 for illiteracy, <20 for those with primary school literacy, and <24 for individuals with secondary education or higher was considered indicative of dementia.

Activities of daily living: We also assessed the Activities of Daily Living (ADL) [13], which evaluated the participants' daily activity ability, including 14 items in two parts: (1) The physical life self-care scale included six items: toileting, eating, dressing, grooming, walking, and bathing; (2) The instrumental daily living ability scale consisted of eight items: making phone calls, shopping, preparing meals, doing housework, doing laundry, using transportation, taking medicine, and taking care of household finances. The total score ranged from 14 to 56. ADL scores ≥22 indicate significant functional impairment.

Assessment of serum cholesterol levels: After obtaining their informed consent, the participants were first instructed to fast for at least 12 hours before blood samples were collected by venipuncture at the partner hospital of this study in the morning. Blood samples from each participant were stored in separate tubes containing silica coagulant. The sample tubes were centrifuged at 3000×g for 10 min to obtain the final serological sample. Total Cholesterol (TC) and Triglyceride (TG) levels were measured using an enzymatic method, whereas Low-Density Lipoprotein Cholesterol (LDL-C) and High-Density Lipoprotein Cholesterol (HDL-C) levels were measured using a homogeneous method.

Assessment of lifestyle factors and other covariates: Through relevant literature and observations in clinical work, the following relevant influencing factors were included: age, sex (male/female), years of education, marital status (unmarried/divorced or widowed/married), handedness (right/left), occupation type (manual/mental), social activities (none or few/poor/moderate/rich), living status (nursing home/alone/with caregiver), smoking status (yes/no), alcohol consumption (yes/no), vascular or heart disorders (cerebral infarction, cerebral hemorrhage, headache, diabetes mellitus, heart disease, epilepsy, hypertension), yes/no. The Body Mass Index (BMI) was calculated as weight/height^2 (kg/m^2).

Data on alcohol consumption were also obtained through self-reports. The definitions for light-to-moderate alcohol consumption were as follows:

Light consumption: 0.01-0.21 fl oz per day (1-13 drinks per month).

Moderate consumption: 0.22-1.00 fl oz per day (4-14 drinks per week) [14].

A drink was defined as 12 oz regular beer, 5 oz wine, or 1.5 oz 80-proof distilled spirits, where 1 oz equals 28.35 g. Moderate consumption included values below the above definition, as the present study considered 'light-to-moderate' consumption as a single group.

Statistical analysis

Among 4013 patients, 3536 eligible questionnaires were finally included. All data were analyzed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as means (± Standard Deviation [SD]), while categorical variables were presented as medians (interquartile ranges) or percentages. Normally distributed variables (age, years of education, BMI, MMSE score, TC, and LDL-C levels) or log-transformed normally distributed variables (TG and HDL-C levels) were analyzed using Student's t-tests, and categorical variables were analyzed using chi-squared tests. ADL scores remained skewed even after logarithmic transformation, so Mann-Whitney U tests were applied.

Logistic regression was performed to examine the associations between dementia and serum cholesterol levels, alcohol consumption, and their interaction, with results reported as Odds Ratios (ORs) and 95% Confidence Intervals (CIs). First, we performed logistic regression to assess the association between alcohol consumption and dementia. Further, analyses examined the relationship of dementia with quartiles, textiles, median levels of TC, TG, HDL-C, LDL-C, after adjusting for age, sex, educational level, occupation, marital status, social activity, and smoking status. Statistical significance was defined as P<0.05.

Univariate logistic regression analysis of the four serum cholesterol indicators (TC, TG, HDL-C, and LDL-C) revealed that only TG levels showed a significant association with dementia. Based on this finding, participants were stratified in (Table 1) by TG levels (quartile, textile, and median) and further categorized by moderate alcohol consumption status.

Results

Baseline characteristics: This study enrolled a total of 3,536 community-based adults aged ≥65 years (female, 56%). The dementia and control groups included 353 (female, 257 [72.8]; age, 74.70±7.05 years) and 3183 (female, 1715 [53.9]; age, 71.73±5.48 years) participants, respectively.

(Table 2) presents the differences in variables between the dementia and control groups. Age (P<0.001*), sex (P<0.001*), years of education (P<001*), occupation type (P=016), marital status (P<0.001*), social activities (P<0.001*), smoking (P<0.001*), alcohol consumption (P<0.001*), TG level (P=0.001*), MMSE score (P<0.001*), and ADL score (P<0.001*) did not differ significantly between the groups.

The age of patients with dementia was generally higher than that of the control group, with more females, fewer years of education, more manual workers, more unmarried or divorced individuals, and fewer social activities. More importantly, light-to-moderate alcohol consumption was significantly lower in the dementia group than in the control group (P<0.001*). Similarly, among the four indices of serum cholesterol, TG levels in the dementia group were generally higher than those in the control group (P<0.001*). Based on these findings, we next analyzed the association between TG levels combined with alcohol consumption and dementia.

Associations between alcohol consumption, TG level, and dementia: (Table 3) shows the associations between light-to-moderate alcohol consumption and dementia and between TG levels and dementia. The OR for the association between light-to-moderate alcohol consumption and dementia was 0.62 (95% CI 0.41-0.94) after adjusting for age, sex, education level, occupation, marital status, social activities, and smoking. After incorporating TG levels into the multivariate logistic analyses considering quartiles, tertiles, and medians, the results showed, using the first quartile (≤0.93 mmol/L) as the reference group, the adjusted ORs for the second, third, and fourth quartiles were 1.06, (95% CI 0.75-1.50), 1.28 (95% CI 0.91-1.8) and 1.42 (95% CI 1.02-1.99), respectively. According to TG tertiles using the first tertile (≤1.05 mmol/L) as the reference group, the adjusted ORs for the second and third tertiles were 1.15 (95% CI 0.85-1.54) and 1.41 (95% CI 1.05-1.89), respectively. According to the TG median using >50% (≤1.335 mmol/L) as the reference group, the adjusted OR for the latter half was 1.31 (95% CI 1.04-1.66). In this cross-sectional study, an association was observed between light-to-moderate alcohol consumption and cognitive function. After adjusting for confounding factors such as age and sex, individuals with light-to-moderate alcohol consumption had a lower risk of developing dementia compared to non - drinkers (OR=0.62, 95% CI 0.41-0.94), suggesting a statistical association with cognitive function. In contrast, an elevated triglyceride (TG) level was significantly associated with the risk of dementia. When the TG level was in a relatively higher grouping, the risk of dementia increased (OR>1), indicating a positive association trend between the TG level and dementia. In addition, the P-value fpor the trend test (P<0.005*) showed that, in the quartile, textile, and median groupings of the TG level, as the TG level increased, the risk of dementia exhibited a statistically significant linear upward trend, reflecting the dose - response characteristic of the association between the two.

(Table 4) shows the results of the multivariate logistic analysis of the TG level quartiles, textiles, and median and the combination group of light-to-moderate drinking and dementia. After adjusting for age, sex, education level, occupation, marital status, social activities, and smoking, the analysis of the association between the combination of TG level quartile and light-to-moderate alcohol consumption and dementia, with Group 1 as the reference group revealed a protective association for dementia in the first TG level quartile with light-to-moderate alcohol consumption compared with the other groups (OR, 0.42; 95% CI, 0.19-0.90). Additionally, light to moderate alcohol consumption is associated with a reduced likelihood of dementia. (OR<1). The analysis of TG level textiles with light-to-moderate alcohol consumption revealed that the third TG level textile and non-alcohol consumption combined demonstrated the closest association with dementia (OR, 1.37; 95% CI, 1.00-1.87). The analysis of the combination of the TG level median and light-to-moderate alcohol consumption revealed the strongest association between non-alcohol consumption and the TG level lower half and dementia (OR, 1.32; 95% CI 1.02-1.69). No significant associations were observed for the relationships between the other three measures of serum cholesterol and dementia, as well as their association with light-to-moderate alcohol consumption and dementia.

Table 1: Light-to-moderate alcohol consumption combined with triglyceride level grouping.

	Group	Light-to-moderate alcohol consumption 0=no 1= yes	Triglyceride (mmol/L)
Light-to-moderate alcohol consumption combined with TG level quartiles	1	0	First quartile (≤0.93)
	2	0	Second quartile (0.94-1.34)
	3	0	Third quartiles (1.35-1.98)
	4	0	Fourth quartiles (≥1.99)
	5	1	First quartiles (≤0.93)
	6	1	Second quartiles (0.94-1.34)
	7	1	Third quartiles (1.35-1.98)
	8	1	Fourth quartiles (≥1.99)

TG: Triglyceride

Statistical significance was defined as two-tailed P<0.05. All models were adjusted for age, sex, education level, occupation, marital status, social activities, and smoking at baseline.

Table 2: Clinical and demographic characteristics of older adult participants.

Characteristics	Dementia group (n=353)	Control group (n=3183)	P-value
Age, years (mean ± SD)	74.70±7.05	71.73±5.48	.000*
Sex, female, n (%)	257 (72.8)	1715 (53.9)	.000*
Handedness, right, n (%)	322 (91.2)	2911 (91.5)	.880
Education, years (Q_2 [Q_1, Q_3])	2 (0, 6)	4 (0, 6)	.000*
BMI, (mean ± SD)	25.83±4.32	25.73±3.90	.645
Occupation type			.016*
Manual worker	349 (98.8)	3070 (96.4)	
Mental worker	4 (1.1)	113 (3.6)	
Marital status			.000*
Unmarried	8 (2.3)	27 (0.8)	
Divorced or widowed	111 (31.4)	722 (22.7)	
Married	234 (66.3)	2434 (76.5)	
Social activities			.000*
None or few	114 (32.3)	628 (19.7)	
Poor	95 (26.9)	760 (23.9)	
Moderate	123 (34.8)	1396 (43.9)	
Rich	21 (5.9)	399 (12.5)	
Living with others			.750
Living in nursing home	5 (1.4)	32 (1.0)	
Living alone	38 (10.8)	331 (10.4)	
Living with caregiver	310 (87.8)	2820 (88.6)	
Smoking, yes, n (%)	54 (15.3)	956 (30.0)	.000*
Alcohol, yes, n (%)	42 (11.9)	885 (27.8)	.000*
Hypertension	48(13.5)	570(17.9)	1.000
Lipid level, mmol/L			
TC (mean ± SD)	5.35±1.12	5.34±1.16	.814
TG (Q_2 [Q_1, Q_3])	1.47 (1.01, 2.14)	1.32 (0.92, 1.97)	.001*
HDL-C (Q_2 [Q_1, Q_3])	1.38 (1.16, 1.63)	1.34 (1.12, 1.62)	.181
LDL-C (mean ± SD)	2.84±0.82	2.76±0.84	.088
MMSE, (mean ± SD)	11.08±4.65	21.32±4.94	.000*
ADL (Q_2 [Q_1, Q_3])	34 (28, 49)	20 (20, 22)	.000*

Values are presented as n (%), mean ± SD, or Q_2 (Q_1, Q_3).

*P<0.05 compared with the control group. Comparisons between the dementia and control groups were performed using x^2 tests for categorical variables and two-tailed Student's t-tests for normally distributed data or normally distributed data after logarithmic transformation.

SD: Standard Deviation; MMSE: Mini-Mental Status Examination; BMI: Body Mass Index; TC: Total Cholesterol; TG: Triglyceride; HDL-C: High-Density Lipoprotein Cholesterol; LDL-C: Low-Density Lipoprotein Cholesterol; ADL: Activities of Daily Living; Q_1: First Quartile; Q_2: Second Quartile; Q3: Third Quartile.

As the ADL scores remained skewed after logarithmic transformation, the Mann–Whitney U test was used to assess the differences.

Table 3: Multivariate logistic regression analysis of the risk of dementia and alcohol consumption or TG levels.

Variables	All	Dementia group (n=353)	Control group (n=3183)	OR (95%CI)	P-value
Alcohol					
0 (No alcohol)	2609	311	2298	1 (reference)	
1 (Alcohol use)	927	42	885	0.62 (0.41, 0.94)	.024*
TG (mmol/L)					
First quartile (≤0.93)	903	70	833	1 (reference)	
Second quartile (0.94-1.34)	865	81	784	1.06 (0.75, 1.50)	.747
Third quartile (1.35-1.98)	888	95	793	1.28 (0.91, 1.80)	.157
Fourth quartile (≥1.99)	880	107	773	1.42 (1.02, 1.99)	.039*
P-trends	-	-	-	-	.014*

Adjusted for age, sex, education level, occupation, marital status, social activities, and smoking.

TG: Triglycerides; OR: Odds Ratio; CI: Confidence Interval; TC: Total Cholesterol; HDL-C: High-Density Lipoprotein Cholesterol; LDL-C: Low-Density Lipoprotein Cholesterol.

Table 4: Odds ratios of the associations between combined triglyceride level grouping and light-to-moderate alcohol consumption with dementia.

	Group	Alcohol	TG	All (n=3536)	Dementia group (n=353)	Control group (n=3183)	OR (95% CI)	P-value
Light-to-moderate alcohol consumption combined with TG level quartiles	1	0	First quartile	588	61	527	1 (reference)	
	2	0	Second quartile	612	66	546	0.93 (0.62, 1.36)	.694
	3	0	Third quartile	688	86	602	1.21 (0.84, 1.74)	.297
	4	0	Fourth quartile	721	98	623	1.31 (0.92, 1.87)	.134
	5	1	First quartile	315	9	306	0.42 (0.19, 0.90)	.026*
	6	1	Second quartile	253	15	238	0.86 (0.45, 1.62)	.633
	7	1	Third quartile	200	9	191	0.66 (0.31, 1.41)	.286
	8	1	Fourth quartile	159	9	150	0.95 (0.44, 2.07)	.902

TG: Triglycerides; OR: Odds Ratio; CI: Confidence Interval.
Adjusted for age, sex, education level, occupation, marital status, social activities, and smoking.

Discussion/Conclusion

The relationship between alcohol consumption and dementia: Although this study adopts a cross-sectional design, an analysis of the research participants' health history data reveals that the onset of light to moderate alcohol consumption predates the appearance of dementia symptoms. This temporal sequence characteristic enables the results of this study to provide a certain degree of reference for exploring the potential causal association between the two to some extent. This study shows the OR for the association between light-to-moderate alcohol consumption and dementia was 0.62 (95% CI 0.41-0.94). The Odds Ratio (OR) indicates an association between light-to-moderate alcohol consumption and a protective effect on cognitive function. Although some previous studies have suggested a potential link between alcohol consumption and cognitive impairment [15], outcomes from two dose-response meta-analyses indicate that light to moderate alcohol intake may lower the risk of dementia onset [16,17]. In line with this evidence, the present study's findings also show that, relative to heavy alcohol consumption, light to moderate alcohol consumption confers a protective effect against dementia. Although some researchers have questioned whether the protective effect of light-to-moderate alcohol consumption on cognitive function stems from survivorship bias [18], the findings of this cross-sectional study provide further evidence supporting the protective role of light-to-moderate alcohol consumption in cognitive function.

The relationship between triglycerides and dementia: The results of the present study showed that, in the absence of alcohol influence, high TG levels were independently associated with dementia. A study investigating the shared etiological factors of vascular disease and dementia [19], reported that serum cholesterol levels constitute a common pathogenic factor for both conditions; additionally, alcohol consumption has been linked to the development of vascular disease [20], further affecting dementia onset [21]. These findings align with those of the present study, which also observed a significant association between TG levels and dementia. This result not only confirms that vascular factors are involved in the pathological mechanisms underlying dementia but also identifies specific targets for exploring the progression of this mechanism. Although the nature of the relationship between TG levels and dementia remains unclear, the trend test results demonstrated that the strength of the association with dementia increased as TG levels rose.

Relationship between alcohol consumption and triglycerides and dementia: One of the most critical findings of the present cross-sectional study was that, at the time of baseline assessment, the first quartile (≤0.93 mmol/L) of Triglyceride (TG) levels in older adult participants with light-to-moderate alcohol consumption exhibited a protective association with dementia compared with other quartile groups. Drawing on previous research indicating that alcohol consumption may reduce cholesterol levels and that light-to-moderate alcohol consumption can lower TG levels [22]. Though the direction of causality remains unclear, the results of this study suggest an association between light-to-moderate alcohol consumption, lower TG levels, and better cognitive function. Further clinical evidence is therefore required to validate this observation. In contrast, serum TG accumulation was identified as a risk factor for dementia in non-drinking participants; thus, healthy strategies targeting TG level reduction may serve as an effective approach for dementia prevention.

In this cross-sectional study, the incidence of cognitive impairment among community-dwelling older adults was approximately 10.0%; this significant proportion suggests the usefulness of the older adult population with dementia for research and observation, as well as the need for more health strategy interventions.

This study screened probable factors affecting dementia in older adults from multiple dimensions, including basic information, social activities, alcohol consumption, smoking, and other perspectives. In this study, in addition to the observed association between TG levels and cognitive function, as well as the correlation between light-to-moderate alcohol consumption and cognitive performance, we also observed significant relationships with sex, occupation, marital status, social activities, smoking, age, years of education, and ADLs, which provide a basis for future studies. Our results suggest the need for multifactor combined interventions to improve dementia in older adults.

The strengths of this study include the importance of the research object, the novelty of the research angle, and the criticality of the research results. Community-dwelling older adults warrant research attention as this population has not only a considerable distribution but also a large number of dementia cases. Previous studies have proposed that light-to-moderate alcohol consumption is beneficial to cognitive function; however, this idea remains controversial, and its mechanism

has not been clarified. The changes in serum cholesterol levels observed in the present study suggest that light-to-moderate alcohol consumption can keep TG levels to a low level and is relatively less likely to lead to dementia. These findings provide practical evidence that light-to-moderate alcohol consumption is beneficial for cognitive function in older adult populations.

Limitations: This study had several limitations. The core conclusion of this study was that light-to-moderate alcohol consumption can improve cognitive function, possibly by reducing TG levels. However, we did not explore in depth the relationship between the effects of alcohol consumption and TG levels, and because the definition of alcohol consumption is not harmonized in the current relevant studies, subsequent studies could start from other perspectives of alcohol consumption levels. Finally, this study offers an explanation for the effect of alcohol consumption on dementia in older adults from the perspective of triglyceride; however, in practice, it is not limited to this perspective, and additional potential mechanisms require further exploration.

Declarations

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Ethical statement: The protocol for this study was reviewed and approved by the Ethics Committee at Tianjin Huanghua Hospital [2019-40]. Informed consent was obtained from each subject either directly or from his or her guardian.

Conflicts of interest: No potential conflict of interest was reported by the authors. This study was approved by the Ethics Committee of the Tianjin Health Service.

Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Consent to participate: Informed consent was obtained from all individual participants included in the study.

Consent for publication: Not applicable.

Code availability: Not applicable.

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