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RESEARCH ARTICLE

Association of the Triglyceride-Glucose Index With Risk of Alzheimer's Disease: A Prospective Cohort Study

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Introduction: Triglyceride-glucose index (TyG) is a reliable surrogate marker of insulin resistance, and insulin resistance has been implicated in Alzheimer's disease pathophysiology. However, the relationship between the TyG index and Alzheimer's disease remains unclear. This study aimed to evaluate the association of the TyG index with the risk of Alzheimer's disease.

Methods: This prospective study included 2,170 participants free of Alzheimer's disease from the Framingham Heart Study Offspring Cohort Exam 7 (1998−2001), whose follow-up data were collected until 2018. The TyG index was calculated as Ln(fasting triglyceride [mg/dL] × fasting glucose [mg/dL]/2). The association of the TyG index with Alzheimer's disease was evaluated by competing risk regression model. Statistical analyses were performed in 2023.

Results: During a median follow-up of 13.8 years, 163 (7.5%) participants developed Alzheimer's disease. When compared with the reference (TyG index ≤8.28), a significantly elevated risk of Alzheimer's disease was seen in the group with a triglyceride-glucose index of 8.68−9.09 (adjusted hazard ratio=1.69, 95% CI=1.02, 2.81). When the TyG index was considered as a continuous variable, each unit increment in the TyG index was not significantly associated with the risk of Alzheimer's disease (adjusted hazard ratio=1.32, 95% CI=0.98, 1.77).

Conclusions: This study showed that moderately elevated TyG index was independently associated with a higher incidence of Alzheimer's disease. TheTyG index might be used to define a high-risk population of Alzheimer's disease.

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INTRODUCTION

Alzheimer's disease (AD) is the most common cause of dementia, accounting for 60%−80% of dementia cases, especially in the older population. Because the prevalence rate has increased over the past few decades, it has placed a considerable burden on health and economic systems.[1] The pathogenesis of AD is extraordinarily complicated and needs to be more fully elucidated. None of the current

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treatments for symptomatic AD could definitively reduce the progression of the disease or improve its prognosis.[2,3] Therefore, it is essential to find a reliable method to identify the high-risk population and prevent AD at an early stage.

Insulin resistance (IR) is a state of insensitivity and reduced responsiveness of target tissues to the effect of insulin. Previous studies have demonstrated that IR in peripheral tissues and the brain may trigger AD by several potential mechanisms, including amyloid β (Aβ) and tau aggregation, synaptic loss, bioenergetic deficiencies, vascular dysfunction, inflammation, and dyslipidemia.[4] Traditional methods for evaluating IR, such as hyperinsulinemic-euglycemic clamp and the homeostasis model assessment−estimated insulin resistance (HOMA-IR), are invasive, expensive, and unavailable in most developing countries, and they may be interfered with by exogenous insulin levels, which limits their applications in clinical practice. The triglyceride-glucose (TyG) index is simply calculated as Ln(fasting triglyceride [mg/dL] × fasting glucose [mg/dL]/2). Compared with the gold standard, the hyperinsulinemic-euglycemic clamp, the TyG index has high sensitivity and specificity, and it has been proven to be superior to HOMA-IR in estimating IR and evaluating the occurrence of carotid atherosclerosis, arterial stiffness, and coronary calcium progression in people with or without diabetes.[5−7] Therefore, the TyG index has been considered a reliable and cost-effective surrogate marker for IR in recent years.

Recent studies have shown that the TyG index is positively associated with the occurrence of diabetes mellitus, cardiovascular diseases, ischemic stroke, and metabolic disorders.[8−10] However, the effect of the TyG index on the incidence of neurodegenerative diseases such as AD remains unclear. Therefore, this study aimed to evaluate the relationship between the TyG index and AD risk using a large community-based dementia-free cohort derived from the Framingham Heart Study (FHS).

METHODS

Study Population

Participants from the FHS Offspring cohort were included in this analysis. To better understand the relationship between the TyG index and AD, participants aged ≥50 years at the time of Exam 7 (1998−2001) were included because the incidence of AD was quite low owing to the young age in Exam 1−6. Furthermore, as shown in Appendix Figure 1 (available online), individuals who were diagnosed with dementia or AD at baseline (Exam 7) or died before the index date (n=1,724) as well as those aged <50 years (n=349), without triglycerides or glucose value (n=193), and with missing covariate data (n=688) were excluded. All the participants provided written informed consent at enrolment. The details of the study design and inclusion criteria have been described elsewhere.[11]

Measures

The primary outcome was the development of AD. Using the time of Exam 7 as the baseline, the follow-up time was recorded until the development of AD, the development of other types of dementia, death, or the end of 2018.

Statistical Analysis

Continuous variables were expressed as either mean±SD or median (IQR). Categorical variables were presented as numbers with proportions (%). The TyG index for each examination was calculated as Ln(fasting triglyceride [mg/dL] × fasting glucose [mg/dL]/2).[12] When taking the TyG index as a categorical variable, all the participants were stratified into quartiles (Quartile 1: 6.96−8.28; Quartile 2: 8.29−8.67; Quartile 3: 8.68−9.09; and Quartile 4: 9.10−12.00) on the basis of their baseline TyG indexes. Baseline characteristics were compared by ANOVA or Kruskal−Wallis test for continuous variables and chi-square tests or Fisher's exact test for categorical variables. The cumulative incidence curve was plotted to assess the unadjusted AD risk stratified by quartiles of baseline TyG index, with comparison by Gray's test.[13] The prognostic relevance of the baseline TyG index for the risk of AD was assessed using multivariable-adjusted competing risk regression models, where other types of dementia and all-cause death were considered as competing events.[13] In these regression analyses, the TyG index was considered a continuous or categorical variable, and the corresponding results were expressed as hazard ratios (HRs) and 95% CIs. The covariates in the multivariable analyses were selected on the basis of a combination of clinical relevance and previous prognostic implication in FHS.[14] Model 1 adjusted for age, sex, education level, and BMI; Model 2 additionally adjusted for current smoking and physical activity index; and Model 3 further adjusted for systolic blood pressure (SBP), cardiovascular disease, antihypertensives, hypoglycemic therapy, and lipid-lowering therapy. Restricted cubic spline was used in a complementary analysis. In addition, the stratified analyses were performed according to age, sex, BMI, current smoking, SBP, hypoglycemic therapy, lipid-lowering therapy, and education level.

To bolster the robustness of the primary findings, this study conducted a series of sensitivity analyses, which are detailed as follows:

1. Lag period analysis: to address the potential latency period of AD from onset to diagnosis, the associations were estimated considering 3 distinct lag periods: 3, 5, and 10 years. These lag periods represent the minimum interval between the baseline TyG index measurement and the occurrence of incident AD. For instance, using a lag of 3 years enabled the investigation of new AD cases that emerged at least 3 years after the baseline TyG index measurement.
2. Complete cases analysis: to examine the association between the baseline TyG index and the risk of AD in participants who completed the assessments through the follow-up period, an additional sensitivity analysis was performed. Specifically, complete cases of Exam 7−9 were utilized (n=1,406).
3. Competing risk regression analysis: to capture the inherent status of IR, this study further employed competing risk regression analyses. These analyses were restricted to participants who did not receive treatment with lipid-regulating agents or antidiabetic drugs at baseline (n=1,605).

Data were collected from 1998 to 2018, and statistical analyses were performed in 2023. All the statistical analyses were performed with R statistical software (Version 4.0.3, The R Foundation for Statistical Computing, Vienna, Austria; tidyverse, survival, cmprsk, smoothHR, and rms packages). The *statistical significance* was defined as a 2-tailed p-value <0.05. This study was approved by the Medical Ethical Committee of the First Affiliated Hospital, Sun Yat-Sen University. More details about the methods used in this study are provided in the Appendix materials (available online).

RESULTS

A total of 2,170 participants were included in this analysis. In terms of baseline characteristics, the mean age was 63.0±8.2 years, and 53.3% of the participants were females. The mean TyG index was 8.7±0.6. As shown in Table 1, the baseline characteristics of participants were stratified according to the quartiles of the TyG index. Participants with higher TyG indices were older, had higher BMI or SBP, and had poorer glucolipid metabolism conditions than those in Quartile 1 (TyG index range from 6.96 to 8.28). Notably, participants in Quartile 4 (TyG index range from 9.10 to 12.00) had a significantly higher prevalence of diabetes mellitus and received more hypoglycemic therapy than those in Quartile 1. In addition, antihypertensive and lipid-lowering therapies were widely applied in participants from the higher TyG index quartiles, especially among those in the Quartile 4 group.

During a median follow-up of 13.8 years, a total of 163 participants (7.5%) were diagnosed with AD. The cumulative incidence curves across different TyG index quartiles suggested that there was a significantly higher risk of AD among participants in the higher TyG index quartiles during the follow-up than among those in Quartile 1 (p=0.028) (Figure 1).

Table 2 shows the associations of the baseline TyG index with the risk of AD using multivariable Cox regression analyses. In Model 1, the risk of AD was significantly higher in participants of Quartile 3 (HR=1.72, 95% CI=1.05, 2.81) than in those of Quartile 1 but not in those of Quartile 2 (HR=1.55, 95% CI=0.95, 2.54) or Quartile 4 (HR=1.48, 95% CI=0.87, 2.50). After adjusting further for smoking, physical activity index, comorbidities, and treatments (i.e., Models 2 and 3 in Table 2), similar results were observed in participants of Quartile 3 compared with those of Quartile 1 (Model 2: HR=1.73, 95% CI=1.06, 2.84; Model 3: HR=1.69, 95% CI=1.02, 2.81).

When the TyG index was considered as a continuous variable, each unit increment in the TyG index was significantly related to a higher risk of AD (HR=1.34, 95% CI=1.02, 1.76) after adjustment for age, sex, education level, and BMI (Model 1). Consistent findings were found in Model 2 (HR=1.36, 95% CI=1.03, 1.79), whereas in the fully adjusted Model 3, the TyG index was not associated with the risk of AD (HR=1.32, 95% CI=0.98, 1.77). Moreover, the restricted cubic spline curve indicated a linear trend of an increased AD risk with a higher TyG index (p-overall<0.001) (Figure 2). Subgroup analyses showed no significant interactions between the TyG index and age, sex, BMI, current smoking, SBP, diabetes mellitus, education level, lipid-lowing therapy, or hypoglycemic therapy (all ps>0.05) (Appendix Figure 2, available online).

To account for the latency period of diagnosing AD from its onset, 3 lag periods of 3, 5, and 10 years were defined. Consistent with the primary findings, those in Quartile 3 had a consistently higher risk of AD in all 3 lag periods than those in the Quartile 1 group but not those in Quartile 2 and Quartile 4 (Appendix Table 1, available online).

Appendix Table 2 (available online) shows the risk of AD across different TyG quartiles using complete cases from Exam 7 to Exam 9. In the multivariable-adjusted models, there were qualitatively similar findings to the primary results, although Model 3 showed an HR for Quartile 3 with marginal statistical significance (HR=2.47, 95% CI=0.99, 6.20, p=0.053).

After excluding participants who received hypoglycemic and lipid-lowering therapies on Exam 7 and reperforming the analyses, similar results were obtained

Table 1. Baseline Characteristics According to Quartiles of TyG Index (N=2,170)

Characteristics	Overall (N=2,170)	TyG index 6.96–8.28 (*n*=542)	8.29–8.67 (*n*=531)	8.68–9.09 (*n*=548)	9.10–12.00 (*n*=549)	*p*-value
Age, years	63.0±8.2	61.8±8.2	63.1±8.3[a]	63.5±8.2[b]	63.4±7.9[c]	**0.001***
Sex (male), *n* (%)	1,014 (46.7)	240 (44.3)	232 (43.7)	263 (48.0)	279 (50.8)	0.062
BMI, kg/m^2	28.1±5.2	25.7±4.5	27.6±5.0[a]	28.8±4.9[b,d]	30.3±5.2[c,e,f]	**<0.001****
Weight, kg	78.9±17.3	72.2±15.9	77.5±17.5[a]	80.4±16.5[b,d]	85.2±16.8[c,e,f]	**<0.001****
Height, cm	167.1±9.5	167.0±9.4	167.2±9.7	166.7±9.7	167.6±9.2	0.529
Heart rate, bpm	64.8±10.9	62.9±10.0	63.4±10.8	66.2±10.6[b,d]	66.9±11.4[c,e,f]	**<0.001****
SBP, mmHg	128.4±18.8	122.7±18.5	128.2±19.2[a]	129.7±17.2[b]	133.0±18.7[c,e,f]	**<0.001****
DBP, mmHg	73.8±9.6	72.1±9.4	73.5±9.7	74.5±9.4[b]	75.0±9.7[c,e]	**<0.001****
Current smoking, *n* (%)	224 (10.3)	52 (9.6)	54 (10.2)	67 (12.2)	51 (9.3)	0.376
Education, *n* (%)						**0.004***
0, lower than high school	155 (7.1)	29 (5.4)	32 (6.0)	39 (7.1)	55 (10.0)[c]	
1, high school graduate	1,068 (49.2)	245 (45.2)	266 (50.1)	284 (51.8)	273 (49.7)[c]	
2, college	947 (43.6)	268 (49.4)	233 (43.9)	225 (41.1)	221 (40.3)[c]	
Physical activity index	37.9±6.4	38.3±6.4	37.8±6.6	37.8±6.6	37.5±6.1	0.175
Total cholesterol, mg/dL	201.0±36.4	191.1±31.7	199.8±35.1[a]	206.1±36.1[b,d]	206.7±40.1[c,e]	**<0.001****
Triglycerides, mg/dL	138.3±86.9	64.1±14.9	100.7±14.8[a]	142.9±22.3[b,d]	243.3±105.2[c,e,f]	**<0.001****
HDL cholesterol, mg/dL	53.7±17.0	64.4±17.2	56.5±16.2[a]	51.2±14.6[b,d]	42.9±11.8[c,e,f]	**<0.001****
LDL cholesterol, mg/dL	120.2±32.3	113.8±28.4	123.2±31.2[a]	126.4±32.7[b]	117.3±35.1[e,f]	**<0.001****
Fasting blood glucose, mg/dL	104.1±25.0	94.2±10.8	98.8±13.5[a]	101.0±12.6[b]	122.0±39.7[c,e,f]	**<0.001****
Baseline TyG index	8.7±0.6	8.0±0.2	8.5±0.1[a]	8.9±0.1[b]$	9.5 ± 0.4[c,e,f]	**<0.001****
Diabetes mellitus, *n* (%)	238 (11.0)	15 (2.8)	28 (5.3)	29 (5.3)	166 (30.2)[c,e,f]	**<0.001****
Cardiovascular disease, *n* (%)	303 (14.0)	50 (9.2)	64 (12.1)	81 (14.8)[b]	108 (19.7)[c,e]	**<0.001****
Atrial fibrillation, *n* (%)	95 (4.4)	17 (3.1)	19 (3.6)	25 (4.6)	34 (6.2)	0.075
Previous stroke, *n* (%)	35 (1.6)	7 (1.3)	6 (1.1)	6 (1.1)	16 (2.9)	0.076
Treated for hypertension, *n* (%)	782 (36.0)	123 (22.7)	177 (33.3)[a]	200 (36.5)[b]	282 (51.4)[c,e,f]	**<0.001****
Treated for diabetes, *n* (%)	143 (6.6)	12 (2.2)	16 (3.0)	20 (3.6)	95 (17.3)[c,e,f]	**<0.001****
Treated for dyslipidemia, *n* (%)	493 (22.7)	64 (11.8)	110 (20.7)[a]	120 (21.9)[b]	199 (36.2)[c,e,f]	**<0.001****
Follow-up (years)	13.4±5.3	14.1±5.0	13.6±5.1	13.2±5.3[b]	12.7±5.7[c,e,f]	**<0.001****

Note: Boldface indicates statistical significance (*$p<0.01$ and **$p<0.001$).
Continuous variables were presented as mean±SD or median (IQR). Categorical variables were as frequency (%).
p-value represents a comparison between groups by the ANOVA for continuous variables and the chi-square test for categorical variables.
[a]$p<0.05$, comparison between quartiles 2 and 1.
[b]$p<0.05$, comparison between quartiles 3 and 1.
[c]$p<0.05$, comparison between quartiles 4 and 1.
[d]$p<0.05$, comparison between quartiles 3 and 2.
[e]$p<0.05$, comparison between quartiles 4 and 2.
[f]$p<0.05$, comparison between quartiles 4 and 3.
DBP, diastolic blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure; TyG, triglyceride-glucose.

(Table 2). The Quartile 3 of the TyG index was associated with a significantly higher risk of AD, whereas Quartile 2 and Quartile 4 were not (Appendix Table 3, available online).

DISCUSSION

In this study, a significant positive association of baseline TyG index with the development of AD was observed among the general population aged ≥50 years in the FHS Offspring cohort. The findings of this study suggested that the TyG index might be a simple indicator for the early detection of a high-risk population for the development of AD.

The TyG index was first proposed by Simental-Mendia et al. in 2008,[12] and it may serve as a superior surrogate marker to HOMA-IR for identifying IR in healthy individuals. As an indicator for IR, the TyG index can reflect the metabolic state of the entire body, which is positively associated with adverse events of peripheral metabolic disorders, such as obesity, diabetes mellitus, and cardiovascular diseases.[15–21] In the realm of neurology, IR has been shown to play a crucial role in the metabolic mechanisms underlying the pathogenesis of

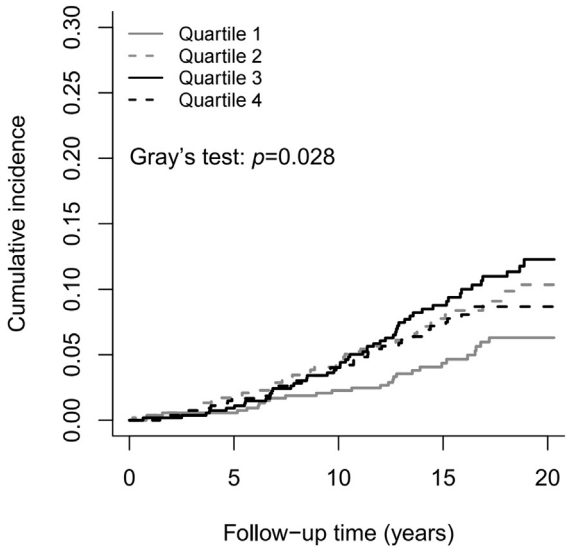

Figure 1. Cumulative incidence curves for incidence of AD according to the quartiles of baseline TyG index.
AD, Alzheimer's disease; TyG, triglyceride-glucose.

AD.[4,22−24] Meanwhile, intranasal insulin administration has been approved to improve episodic memory in patients with AD and modulate Aβ accumulation during the early stage of the disease.[25,26] Therefore, it is imperative to investigate the relationship between the TyG index and the risk of AD.

Recent epidemiologic studies have revealed that the onset of AD is influenced by various factors, including age and genetics, which cannot be altered, as well as risk factors such as blood pressure and lifestyle.[14,27] This study further establishes that the TyG index is an independent risk factor of AD because a significantly higher risk of AD was observed in Quartile 3 (TyG index: 8.68−9.09) than in Quarter 1 (TyG index: ≤8.28). These results are consistent with prior findings by Schrijvers et al,[28] which showed that each doubling of IR led to a 40% increase in incident AD. Notably, after adjusting for clinical comorbidities, the observed risk of AD in Quartile 4 (TyG index: 9.10−12.00) was no longer significantly higher than in Quartile 1. This could be due to the potential beneficial effects of the widespread use of hypoglycemic and lipid-lowing therapies on IR (Table 1), which may modify the association of the TyG index with the risk of AD.

The specific mechanisms for the association of the TyG index with AD are yet to be fully elucidated. Several possible pathophysiologic explanations have been proposed previously. First, IR-induced dysregulation of insulin-dependent glucose transport in the brain could lead to impaired synaptic, metabolic, and immune response functions in specific brain regions.[29] Previous studies have demonstrated that IR in the brain contributes to neurodegeneration and development of AD by accelerating Aβ deposition,[30] Tau protein hyperphosphorylation and aggregation,[31,32] neuroinflammation,[4] and oxidative stress.[33] As an indicator of IR and the status of glucose and lipid metabolism, the TyG index could be influenced by the activity of metabolic-associated biological factors such as protein kinase C.[34] In addition, stroke and AD share several pathophysiological mechanisms, including Aβ toxicity, neuroinflammation, and oxidative stress.[35] As noted earlier, some of these shared mechanisms may also contribute to the association between the TyG index and AD. Second, at the molecular level, IR may stem from 3 fundamental changes, including a reduction in insulin-binding affinity, a decrease in insulin receptor concentration, and a disruption of the insulin signaling cascade.[4,36,37] On the basis of the substrate changes in the insulin signaling cascade in the brain, IR in the brain can be evaluated by a greater ratio of phosphorylated serine to total phosphorylated insulin receptor substrate and neuronal-enriched extracellular vesicles in the plasma.[38,39] Third, there is a reciprocal relationship between insulin sensitivity in peripheral tissue and the brain.[4,36] Therefore, IR in the brain can be indirectly evaluated by methods for peripheral IR, such as a hyperinsulinaemic-euglycaemic clamp, HOMA-IR,[28] and the TyG index. Finally, it is noteworthy that the TyG index is essentially the sum of the logarithms of fasting plasma glucose and triglyceride, and recent studies have demonstrated a positive association between disorders of lipid or glucose metabolism and the development of AD.[40−43] Thus, controlling lipid and glucose metabolism to appropriate levels may offer benefits for the general population aged >50 years in preventing the onset of AD.

Through this research, the scarce evidence regarding the correlation between the TyG index and AD is expanded. As a simple biomarker that can be easily obtained during clinical practice, the TyG index has the potential for widespread application in identifying individuals at higher risk of AD at an early stage, especially among those from low-income backgrounds or disadvantaged socioeconomic environments. Furthermore, the TyG index may aid in directing pharmacological treatments or lifestyle interventions designed to modify IR, ultimately preventing the onset of AD.

Limitations

There are several limitations to this study. First, because of the nature of observational cohort studies, definitive conclusions as to whether the increasing TyG index was the cause of AD development could not be drawn.

Table 2. Association of Baseline TyG Index With Risk of Alzheimer's Disease

TyG index	Events, *n* (%)	Event rate per 100 person-years	Risk of Alzheimer's disease							
			Crude model		Model 1		Model 2		Model 3	
			HR (95% CI)	*p*-value	HR (95% CI)	*p*-value	HR (95% CI)	*p*-value	HR (95% CI)	*p*-value
Overall[a]	163 (7.5)	0.56 (0.48, 0.65)	1.28 (1.03, 1.6)	**0.027***	1.34 (1.02, 1.76)	**0.037***	1.36 (1.03, 1.79)	**0.031***	1.32 (0.98, 1.77)	0.064
Quartiles[b]										
6.96–8.28	27 (5.0)	0.4 (0.2, 0.5)	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
8.29–8.67	44 (8.3)	0.6 (0.4, 0.8)	1.72 (1.06, 2.77)	**0.027***	1.55 (0.95 2.54)	0.078	1.60 (0.98, 2.63)	0.061	1.59 (0.97, 2.62)	0.069
8.68–9.09	52 (9.5)	0.7 (0.5, 0.9)	1.99 (1.25, 3.17)	**0.004****	1.72 (1.05, 2.81)	**0.030***	1.73 (1.06, 2.84)	**0.029***	1.69 (1.02, 2.81)	**0.040***
9.10–12.00	40 (7.3)	0.6 (0.4, 0.8)	1.51 (0.93, 2.47)	0.096	1.48 (0.87, 2.50)	0.150	1.52 (0.89, 2.59)	0.120	1.39 (0.80, 2.41)	0.250

Note: Boldface indicates statistical significance (*$p<0.05$ and **$p<0.01$).
Model 1 is adjusted for age at Exam 7, sex, education level (lower or higher than high school), and BMI. Model 2 is additionally adjusted for current smoking and physical activity index. Model 3 is additionally adjusted for SBP (categorical variable, >140 mmHg or ≤140 mmHg), cardiovascular disease, antihypertensives, hypoglycemic therapy, and lipid-lowering therapy. Events, presented as *n* (%), is the number and percentage of Alzheimer's disease cases per group.
[a]TyG index was included as a continuous variable.
[b]TyG index was included as a categorical variable.
HR, hazard ratio; SBP, systolic blood pressure; TyG, triglyceride-glucose.

Figure 2. Association between baseline TyG index and risk of AD.
The plot was adjusted for age at Exam 7, sex, BMI, education level, physical activity index, SBP, diabetes, current smoking, cardiovascular disease, atrial fibrillation, antihypertensives, hypoglycemic therapy, and lipid-lowering therapy. A TyG index level of 8.68 (median) was set as the reference. The solid red line represents the hazard ratio of the TyG index across the whole range. Black dotted lines represent the 95% CI. The gray dotted line is the reference line because the hazard ratio was 1. Histograms represent the proportion distribution of the baseline TyG index. AD, Alzheimer's disease; SBP, systolic blood pressure; TyG, triglyceride-glucose.

Second, whether the TyG index could be an indicator to assess the stage of AD if a patient has been diagnosed with AD remains unknown. Third, although the TyG index has been proven to be a surrogate marker for IR in peripheral tissues with high sensitivity and specificity, the relationship of the TyG index with IR in the brain should be further confirmed. Finally, because of the limitations of the original study design and data collection, some potential confounders, especially at the genetic level such as ApoE and TREM2,[44,45] were not measured. The influence of potential unmeasured confounders on the effect of the TyG index on AD risk needs to be investigated in future studies.

CONCLUSIONS

This study suggested that an elevated TyG index was independently associated with a higher incidence of AD. The TyG index might help define populations at higher risk of AD.

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contributed equally as corresponding authors. All the participants provided written informed consent at enrolment. This study was approved by the Medical Ethical Committee of the First Affiliated Hospital, Sun Yat-sen University for the use of deidentified publicly available data. The data underlying this article will be shared upon reasonable request to the corresponding author. The publicly available data of FHS can be accessed through the NIH database of genotypes and phenotypes (https://www.ncbi. nlm.nih.gov/gap/).

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SUPPLEMENTAL MATERIAL

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