Letter

Associations of Types and Intakes of Staple Foods with Mild Cognitive Impairment in Chinese Elderly: A Prospective Cohort Study

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Dementia is a growing global health burden, with mild cognitive impairment (MCI) serving as a critical transitional stage[1]. Identifying the nutritional risk factors is crucial for prevention. While nutrition plays a key role in preventing age-related diseases and staple foods are a major dietary source, existing research on cognitive function has predominantly emphasized whole-grain consumption. There is limited evidence regarding the effects of specific staple food types on MCI.

Platelet (PLT) levels are regarded as a potential indicator of low-grade inflammation[2], and platelet distribution width (PDW) serves as a reliable marker of platelet activation. Considering that chronic inflammation contributes to cognitive decline and is influenced by dietary patterns, PLT and PDW may mediate the association between staple food consumption and MCI.

To address this absence of knowledge, we used data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS) to explore the relationships of types and intakes of staple foods with MCI and the mediation effects of PLT and PDW on this association in the elderly in China.

A total of 21,283 participants aged ≥ 65 years at baseline with complete data were included. The exclusion criteria were defined as age < 65 years; baseline MCI, stroke, Parkinson's disease, or dementia; missing data on education, staple food types/intakes, or covariates; lack of follow-up for participants in the 2018 wave. For the biomarker sub-study, PLT and PDW data from the CLHLS were available for 1,323 participants after excluding those with missing biomarker data or MCI at the time of biomarker measurement. Given the scarcity of coarse cereal consumers (n = 12), the mediation analysis was confined to 1,311 individuals primarily consuming rice and wheat, as shown in Supplementary Figure S1.

Cox proportional hazard regression models were used to estimate hazard ratios (*HRs*) and 95% confidence intervals (*CIs*) for the associations of staple food types (rice as a reference) and intakes (per standard deviation increase) with incident MCI. Subgroup analyses were stratified by sex, age, and living areas. A restricted cubic spline analysis with three knots placed at the 5th, 50th, and 95th percentiles was performed, using the recommended daily intake of staple foods (300 g) as a reference point. Bootstrap analysis was employed to assess the mediation effects of PLT and PDW on the association between staple foods and MCI. A comprehensive description of the methods is provided in Supplementary Material.

Supplementary Table S1 outlines the initial demographic profiles of 21,283 participants [age: 85 ± 11 years, 46% male). Among them, 16,343 (77.0%) consumed rice as their staple food, 905 (4.3%) consumed coarse cereals as their staple food, and 4,035 (19%) consumed wheat as their staple food. During the median follow-up of 3 years, 4,898 cases of MCI were recorded.

Table 1 shows that, after adjusting for covariates, compared with rice, wheat was associated with an 18.7% higher incidence of MCI (*HR*: 1.187; 95% *CI*: 1.057–1.333). There was no significant difference in the risk of MCI between coarse cereals and rice as staple foods (P = 0.487). Similar associations were observed in living areas. For men, compared with rice, wheat was associated with a 24.2% higher incidence of MCI (*HR*: 1.242; 95% *CI*: 1.037–1.486). For participants aged 65–<80 years, compared with rice, wheat was associated with a 22.1% higher incidence of MCI (*HR*: 1.221; 95% *CI*: 1.024–1.456).

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Table 1. Associations of types of staple foods with mild cognitive impairment

Subgroups	Types of staple foods	*HR* (95% *CI*)	*P*	*P* for interaction[e]
Total samples (*N* = 21,283)[a]	Rice	1.000		
	Coarse cereals	1.100 (0.841–1.440)	0.487	
	Wheat	1.187 (1.057–1.333)	0.004	
Sex[b]				0.341
Males (*n* = 9,822)	Rice	1.000		
	Coarse cereals	1.217 (0.877–1.690)	0.240	
	Wheat	1.242 (1.037–1.486)	0.018	
Females (*n* = 11,461)	Rice	1.000		
	Coarse cereals	1.058 (0.747–1.499)	0.850	
	Wheat	1.157 (0.994–1.348)	0.061	
Age (years)[c]				0.572
65– (*n* = 5,808)	Rice	1.000		
	Coarse cereals	1.079 (0.782–1.488)	0.645	
	Wheat	1.221 (1.024–1.456)	0.026	
80– (*n* = 7,171)	Rice	1.000		
	Coarse cereals	1.189 (0.812–1.742)	0.373	
	Wheat	1.143 (0.975–1.340)	0.100	
≥ 90 (*n* = 8,304)	Rice	1.000		
	Coarse cereals	0.955 (0.677–1.349)	0.795	
	Wheat	1.400 (1.199–1.634)	< 0.001	
Living areas[d]				0.457
Urban (*n* = 8,774)	Rice	1.000		
	Coarse cereals	1.164 (0.829–1.634)	0.381	
	Wheat	1.219 (1.022–1.454)	0.028	
Rural (*n* = 12,509)[d]	Rice	1.000		
	Coarse cereals	1.087 (0.779–1.515)	0.624	
	Wheat	1.161 (1.007–1.339)	0.040	

Note. [a] Age, sex, staple food intake, body weight, ethnicity, living areas, marital status, education level, living alone, fruit intake, vegetable intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. [b] Age, staple food intake, body weight, ethnicity, living areas, marital status, education level, living alone, fruit intake, vegetable intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. [c] Sex, staple food intake, body weight, ethnicity, living areas, marital status, education level, living alone, fruit intake, vegetable intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. [d] Age, sex, staple food intake, body weight, ethnicity, marital status, education level, living alone, fruit intake, vegetable intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. [e] *P* for interaction indicates the multiplicative interaction between types of staple foods and sex, age, and living areas on the prevalence of MCI. MCI, mild cognitive impairment.

For participants aged ≥ 90 years, compared with rice, wheat was associated with a 40.0% higher incidence of MCI (*HR*: 1.400; 95% *CI*: 1.199–1.634). There were no significant interaction terms between types of staple foods and sex, age, and living areas.

Table 2 indicates that an increase per standard deviation in wheat intake was associated with a 7.1% higher incidence of MCI (*HR*: 1.071; 95% *CI*: 1.009–1.138). No significant associations were found for rice, coarse cereals, or total staple foods intake (*P* = 0.651, 0.190, and 0.167, respectively). Subgroup analyses revealed no significant associations between staple foods intakes and MCI risk in men, participants aged 65–<80 years, participants aged 90 years and older, and those living in rural areas. In contrast, higher wheat intake (*HR*: 1.125; 95% *CI*: 1.033–1.226) and overall staple foods intake (*HR*: 1.074; 95% *CI*: 1.008–1.145) were associated with an increased MCI incidence in women. For participants aged 80–<90 years, increased intakes of rice (*HR*: 1.093; 95% *CI*: 1.016–1.176), coarse cereals (*HR*: 1.100; 95% *CI*: 1.033–1.171), wheat (*HR*: 1.145; 95% *CI*: 1.058–1.240), and total staple foods (*HR*: 1.092; 95% *CI*: 1.035–1.151) were associated with a higher incidence of MCI. Urban residents with higher wheat intake also showed an increased risk of MCI (*HR*: 1.129; 95% *CI*: 1.022–1.246). Sex, age, and living areas interacted with total staple foods intake, but not with rice, coarse cereals, and wheat intake.

As illustrated in Supplementary Figure S2, the intake of rice and wheat showed a dose-response relationship with the risk of MCI. Our study identified a U-shaped correlation between rice intake and the risk of MCI, whereas wheat intake exhibited an inverse U-shaped correlation with the risk of MCI. The risk of MCI in elderly individuals was lower when they consumed approximately 300 g of rice daily.

We explored the mediation effects of PLT and PDW on the association between types of staple foods and MCI. Owing to the limited sample size (*n* = 1,311), we analyzed the baseline characteristics of the main sample and mediation analysis sub-samples. There were no significant differences in the intake of staple foods (*P* = 0.869), sex (*P* = 0.060), education level (*P* = 0.246), history of hypertension (*P* = 0.251), diabetes (*P* = 0.467), and coronary heart disease (*P* = 0.057) between the biomarker sub-sample and the whole cohort; however, there were significant differences in age and body weight, as shown in Supplementary Table S2. PLT and PDW partially mediated this association, with proportions of 32.04% and 13.90%, respectively (Table 3). PLT mediated the association of intakes of wheat and intakes of total staple foods with MCI, PLT partly mediates this association, with the proportion being 18.25% for intakes of wheat and 12.25% for intakes of total staple foods, as shown in Supplementary Table S3.

In this longitudinal study, participants whose primary staple was wheat had a higher rate of cognitive impairment than those whose primary staple was rice. Our analysis also revealed a dose-dependent link between rice and wheat consumption and MCI risk, with a U-shaped and inverse U-shaped association for rice and wheat intake, respectively. Furthermore, PLT and PDW partially mediated the relationship between staple foods consumption and cognitive decline.

Rice and wheat are staple foods of the Chinese population. Although the association between wheat intake and MCI was statistically significant (*HR* = 1.187), the small effect size suggests limited clinical relevance at the individual level. Previous research revealed that greater rice consumption is linked to enhanced cognitive ability in multiple areas[3]. Our results are consistent with these findings. Moreover, research suggests that eating moderate amounts of cooked white rice may slow cognitive decline and lower the risk of MCI in Korean adults aged over 50[4]. A growing body of research continues to demonstrate a connection between rice consumption and cognitive function. However, findings from a CLHLS-based cross-sectional analysis revealed no significant relationship between dietary staple intake and cognitive impairment risk[5]. This inconsistency could stem from the cross-sectional design of the study, which only assessed current grain consumption without considering its long-term effects on cognition. The results of these studies indicate that individuals consuming wheat as a primary food source may have an elevated risk of developing MCI compared with those consuming rice.

Both rice and wheat contain carbohydrates that may influence post-meal glycemic responses, which have been discussed in relation to cognitive health. Refined wheat products are digested more quickly and contain less fiber, whereas rice may produce different glycemic effects depending on the type and preparation. These factors could help contextualize the differences observed in previous studies; however, the mechanisms remain uncertain. Since we did not collect blood glucose data, such explanations are speculative and require further investigation.

Table 2. Associations of intakes of staple foods (per SD) with mild cognitive impairment

Subgroups	Types of staple foods	*HR* (95% *CI*)	*P*
Total sample (N = 21,283)[a]	Rice	1.015 (0.952–1.081)	0.651
	Coarse cereals	1.034 (0.984–1.087)	0.190
	Wheat	1.071 (1.009–1.138)	0.025
	Total staple foods	1.033 (0.987–1.081)	0.167
Sex [e]			
Males (n = 9,822)[b]	Rice	0.956 (0.871–1.049)	0.344
	Coarse cereals	1.016 (0.946–1.092)	0.656
	Wheat	1.015 (0.931–1.106)	0.735
	Total staple foods	0.990 (0.925–1.059)	0.769
Females (n = 11,461)[b]	Rice	1.071 (0.982–1.168)	0.123
	Coarse cereals	1.051 (0.981–1.126)	0.160
	Wheat	1.125 (1.033–1.226)	0.007
	Total staple foods	1.074 (1.008–1.145)	0.027
Age (years)[f]			
65– (n = 5,808)[c]	Rice	0.913 (0.829–1.005)	0.064
	Coarse cereals	0.978 (0.907–1.055)	0.563
	Wheat	0.979 (0.979–1.068)	0.632
	Total staple foods	0.949 (0.885–1.019)	0.151
80– (n = 7,171)[c]	Rice	1.093 (1.016–1.176)	0.018
	Coarse cereals	1.100 (1.033–1.171)	0.003
	Wheat	1.145 (1.058–1.240)	0.001
	Total staple foods	1.092 (1.035–1.151)	0.001
≥ 90 s (n = 8,304)[c]	Rice	0.906 (0.816–1.006)	0.066
	Coarse cereals	0.955 (0.874–1.044)	0.310
	Wheat	1.067 (0.970–1.175)	0.183
	Total staple foods	0.969 (0.898–1.046)	0.419
Living areas[g]			
Urban (n = 8,774)[d]	Rice	1.061 (0.971–1.158)	0.191
	Coarse cereals	1.053 (0.977–1.135)	0.178
	Wheat	1.129 (1.022–1.246)	0.016
	Total staple foods	1.062 (0.997–1.132)	0.062
Rural (n = 12,509)[d]	Rice	0.997 (0.921–1.081)	0.948
	Coarse cereals	1.027 (0.967–1.091)	0.383
	Wheat	1.047 (0.974–1.125)	0.213
	Total staple foods	1.019 (0.962–1.079)	0.525

Note. [a] Age, sex, body weight, ethnicity, living areas, marital status, education level, living alone, fruit intake, vegetable intake, meat intake, fish intake, egg intake, bean intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. [b] Age, body weight, ethnicity, living areas, marital status, education level, living alone, fruit intake, vegetable intake, meat intake, fish intake, egg intake, bean intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. [c] Sex, body weight, ethnicity, living areas, marital status, education level, living alone, fruit intake, vegetable intake, meat intake, fish intake, egg intake, bean intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. [d] Age, sex, body weight, ethnicity, marital status, education level, living alone, fruit intake, vegetable intake, meat intake, fish intake, egg intake, bean intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. [e] indicates the multiplicative interaction between sex and total staple food intake on the prevalence of MCI (P = 0.024). [f] indicates the multiplicative interaction between age and total staple food intake on the prevalence of MCI (P = 0.002). [g] indicates the multiplicative interaction between living areas and total staple food intake on the prevalence of MCI (P = 0.008). MCI, mild cognitive impairment.

Our research reveals a U-shaped relationship between overall rice consumption and the likelihood of developing MCI. Participants consuming approximately 300 g of rice daily demonstrated the most favorable cognitive outcomes, consistent with the nutrient intake levels of cereals recommended in the Chinese Dietary Guidelines[6]. Prior research demonstrates that higher rice consumption reduces the likelihood of MCI compared with the lowest intake level. However, beneficial effects are observed at moderate consumption levels in the third quartile rather than in the top quartile[3]. These findings are consistent with current research outcomes. Moreover, they indicate that adhering to the suggested rice intake guidelines may help lower the likelihood of developing cognitive dysfunction.

Table 2 reports the linear association of intakes (increase per SD) of staple foods with incidence of MCI. The restricted cubic spline indicates a non-linear (U-shaped) association, whereas Table 2 cannot capture this pattern and therefore shows an overall positive association. The discrepancy between Supplementary Figure S2B and Table 2 primarily reflects differences in modeling approaches.

Prior research has demonstrated a notable correlation between specific dietary patterns and food selections and the prevalence of chronic low-grade inflammation[2]. Wheat is a rich source of gluten and short-term gluten-free diets can have anti-inflammatory effects in healthy individuals[7]. Conversely, high dietary wheat starch can contribute to the development of inflammatory processes[8]. Therefore, wheat may have a stronger pro-inflammatory effect than rice. PLT is a frequently utilized potential biomarker for low-grade inflammation. Persistent low-grade inflammation worsens neural deterioration and disrupts intricate signaling between neuroglial cells, ultimately accelerating cognitive impairment[9]. Additionally, growing evidence suggests that platelets may play a key role in the development of Alzheimer's disease. A hallmark of this condition is the buildup of amyloid beta (Aβ) peptides, which form the characteristic senile plaques. Activated PLT results in the expression of substantial quantities of amyloid precursor protein, which subsequently releases beta-amyloid[10], and these platelet-generated Aβ peptides can then cross the blood-brain barrier, adding to the dangerous accumulation of amyloid plaques in the brain. Therefore, PLT and PDW may play a mediating role in the relationship between staple foods consumption and MCI in elderly individuals.

In the sensitivity analysis, excluding participants who died within 3 years of baseline did not significantly alter the results of the complete dataset, as shown in Supplementary Table S4. A multilevel Cox proportional hazard regression model with province as a random term yielded results similar to those observed previously. The population that primarily consumes wheat is at a higher risk of MCI than those who primarily consume rice, as shown in Supplementary Table S5. Competing risk Cox proportional hazard regression models demonstrate that individuals who primarily consume wheat have a higher risk of MCI than those who primarily consume rice (Supplementary Table S6). In the biomarker sub-sample, we additionally included staple food type, intake level, PLT, and PDW in the Cox proportional hazards model, and the results were generally consistent with those observed in the

Table 3. The mediation effects of PLT and PDW on the associations of types of staple foods with mild cognitive impairment (*N* = 1,311)

Mediator	Types of staple foods	Total effect (95% *CI*)	*P*	Direct effect (95% *CI*)	*P*	Indirect effect (95% *CI*)	*P*	Proportion mediated (%)	*P*
PLT	Rice (*n* = 964)	Ref							
	Wheat (*n* = 347)	0.524 (0.345–0.596)	< 0.001	0.353 (0.126–0.499)	< 0.001	0.171 (0.080–0.285)	< 0.001	32.04	< 0.001
PDW	Rice (*n* = 964)	Ref							
	Wheat (*n* = 347)	0.519 (0.342–0.592)	< 0.001	0.441 (0.234–0.546)	< 0.001	0.077 (0.028–0.143)	< 0.001	13.90	< 0.001

Note. [a] Age, sex, body weight, ethnicity, living areas, marital status, education level, living alone, fruit intake, vegetable intake, smoking status, alcohol consumption status, physical activity, self-reported health, history of coronary heart disease, history of diabetes, and history of hypertension were adjusted. PLT, platelet count; PDW, platelet distribution width.

main analyses, as shown in Supplementary Table S7.

When mortality was considered a competing event, the association between rice and coarse cereal intake and MCI became significant. This indicates that death substantially influences the exposure-outcome relationship in this elderly cohort. Cox proportional hazard regression models censor deaths and may underestimate this risk. Competing risk Cox proportional hazard regression models provide complementary insights. These findings emphasize that the effects of staple foods on MCI should be interpreted with caution.

The advantages of this nationwide survey include its prospective design, large sample size of older adults, and long follow-up period. However, this study has several limitations. First, it focused solely on the survey of older adults in China. Given the differences in lifestyle and other factors, the findings of this study are unlikely to be extrapolated to other populations. Second, staple food classification relied on a single self-reported item, which may not accurately reflect mixed-staple dietary patterns, and may introduce exposure misclassification. Additionally, information on food processing methods, specific wheat product types, accompanying foods, and total energy intake was not available, limiting further exploration of the potential mechanisms. Third, according to traditional Chinese dietary habits, the staple foods choices of the elderly are usually relatively stable and do not change frequently. Therefore, this survey assumes that the staple foods of the elderly will not change in the short term; therefore, no staple foods that change over time were collected.

In conclusion, we demonstrate that specific types of staple foods are associated with an increased risk of MCI. Wheat consumption is linked to an increased incidence of MCI compared to rice as a staple food. Additionally, there is a non-linear relationship between rice intake and MCI risk. Consuming the recommended amount of rice is associated with a reduced risk of MCI. Furthermore, PLT and PDW partially mediate the association between staple foods consumption and MCI in elderly individuals. These findings suggest that elderly individuals may benefit from consuming rice as their staple food to prevent cognitive decline.

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Competing Interests The authors report there are no competing interests to declare.

Ethics The CLHLS study was approved by the Institutional Review Board of Duke University (Pro00062871) and the Biomedical Ethics Committee of Peking University (IRB00001052–13074).

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Data Sharing The data collected for this study is available to other parties via the following website: https://opendata.pku.edu.cn/dataverse/CHADS. The supplementary materials will be available in www.besjournal.com.

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