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Original Study

Sex Difference in the Association Between Protein Intake and Frailty: Assessed Using the Kihon Checklist Indexes Among Older Adults

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A B S T R A C T

Background: Dietary protein intake is inversely associated with physical frailty risk. However, it is unknown whether an association exists between dietary protein intake and comprehensive frailty.
Objective: To evaluate the association between protein intake and comprehensive frailty in older Japanese adults.
Design, setting and participants: This cross-sectional study included 5638 Japanese participants (2707 men and 2931 women) aged ≥65 years from Kameoka City, Kyoto, Japan.
Measurements: Dietary intake was estimated using a validated self-administered food frequency questionnaire. Comprehensive frailty was assessed using a 25-item Kihon Checklist (KCL), which comprised instrumental activities of daily living, mobility disability, malnutrition, oral or eating function, socialization and housebound, cognitive function, and depression domains. A KCL score of 4 to 6 was defined as prefrailty, and ≥7 as frailty.
Results: In women, but not in men, protein intake showed a lower prevalence for prefrailty (Q1-Q4, 40.2%, 34.3%, 34.3%, and 36.0%). Higher protein intake was associated with lower prevalence of frailty both in men (32.5%, 28.4%, 28.3%, and 27.3%) and women (35.7%, 31.4%, 27.6%, and 28.2%). Moreover, higher dietary protein intake decreased the odds ratio (OR) for frailty after adjustment for potential confounding factors in both men (OR for highest vs lowest quartile, 0.62; 95% CI, 0.43-0.89; *P* for trend = 0.016) and women (OR 0.64; 95% CI, 0.45-0.91; *P* for trend = 0.017).
Conclusions/implications: The higher dietary protein intake may be inversely associated with the prevalence of comprehensive frailty in Japanese men and women. Future studies are needed to examine associations of dietary protein intake within KCL domains.

Frailty is a geriatric syndrome that is characterized by decrease in the physiologic reserve and the resistance to stressors as well as increased vulnerability to adverse events.[1] The frailty phenotype consists of unintentional weight loss, global muscle weakness, exhaustion or poor endurance, slowed performance, and low physical

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activity.[1] Traditionally, frailty has been viewed as a unidimensional concept focusing mainly on the physical problems that older adults experience. However, in recent approaches to frailty, it has been seen as a component of the multidimensional phenotype, including physical frailty and the decline in psychological and sociological frailty.[2,3] Fried et al[1] and Xue et al[3] presented the "cycle of frailty" to accurately assess for frailty (Figure 1).

In Japan, the Kihon Checklist (KCL) was developed by the Japanese Ministry of Health, Labor and Welfare to screen for future risks of long-term care certification.[4,5] Recently, the KCL was validated for use in screening community-dwelling older residents for frailty, translated into other languages, and used in various countries.[6,7] The strength of KCL includes its use in the assessment of physical, sociological, and psychological domains as a comprehensive questionnaire (Supplemental Table 1).

Current evidence has shown that frailty is strongly associated with various risk factors. Frailty risk increases with age; the incidence of geriatric frailty is about 20% to 30% in older adults aged >75 years.[8] Low socioeconomic status, as assessed by either lower educational or lower income levels, showed association with higher frailty risk.[1] Psychological disorders such as depression had an impact on frailty in older adults.[9] Moreover, lifestyle factors such as low physical activity, alcohol, and smoking are contributory factors of frailty.[10–12]

Malnutrition is an essential lifestyle factor of frailty risk (especially physical frailty risk) in free-living and institutionalized older adults.[13–15] Ensuring optimal energy intake is important for the prevention of frailty.[15] In addition, low energy intake is very closely linked to low protein intake, because energy and protein intakes are important factors for preventing frailty risks. Epidemiologic studies have shown that low dietary protein intake is associated with the loss of muscle mass, lower physical function, and performance,[16,17] whereas dietary protein intake has been inversely associated with frailty risk.[13,18,19] To our knowledge, there has been only 1 cross-sectional study of protein intake and frailty risk in Japanese older women.[19] However, these studies were limited because the association occurred with only physical frailty. There has been no evidence of the association between protein intake and comprehensive frailty (ie, physical, sociological, and psychological domains).

The objective of the present study was to evaluate the association between protein intake and comprehensive frailty assessed by the KCL index in both Japanese men and women.

Subjects and Methods

Study Subjects

We conducted a population-based Kyoto-Kameoka Study in July 2011 in Kameoka City, Kyoto, Japan, the details of which have been described elsewhere.[20–22] In brief, 12,054 people (response rate 73.2%) were asked to complete our baseline survey. The Health and Nutritional Survey (additional survey) was conducted on 8319 people (valid response rate 69.4%) in February 2012. For the present study, we excluded 2681 subjects with missing data on KCL score (n = 2545) and subjects with extremely low or high dietary energy intake (n = 136). Finally, data on 5638 subjects (2707 men and 2931 women) were included in the analysis. Ethics Committee of Kyoto Prefectural University of Medicine (RBMR-E-363) and the National Institute of Health and Nutrition (NIHN187-3), approved the study protocol.

Measurements and Data Collection

Dietary intake was assessed using a validated self-administered food frequency questionnaire (FFQ).[23–26] In this FFQ, we asked participants to report their frequency of intakes of 46 food and beverage (green tea and coffee) items over the past year to assess the average intakes.[20,22] The total energy intake and nutrients were calculated using a program developed at the Department of Public Health, Nagoya City University School of Medicine,[23–26] based on the standard tables of food consumption in Japan (fifth revised edition).[27]

Frailty was assessed using the KCL index, which consists of 25 items and 7 domains, and is a self-administrated questionnaire.[6,28] Prefrailty was defined as 4 to 6 points whereas frailty was defined as ≥7 points.

This self-administered questionnaire that included questions on height, weight, family structure, education, history of disease (if the reply for any one of the following diseases is yes—cardiovascular disease, stroke, cancer, diabetes, hypertension, dyslipidemia, stomach/liver/gallbladder, or kidney/prostate), alcohol, and smoking status, as

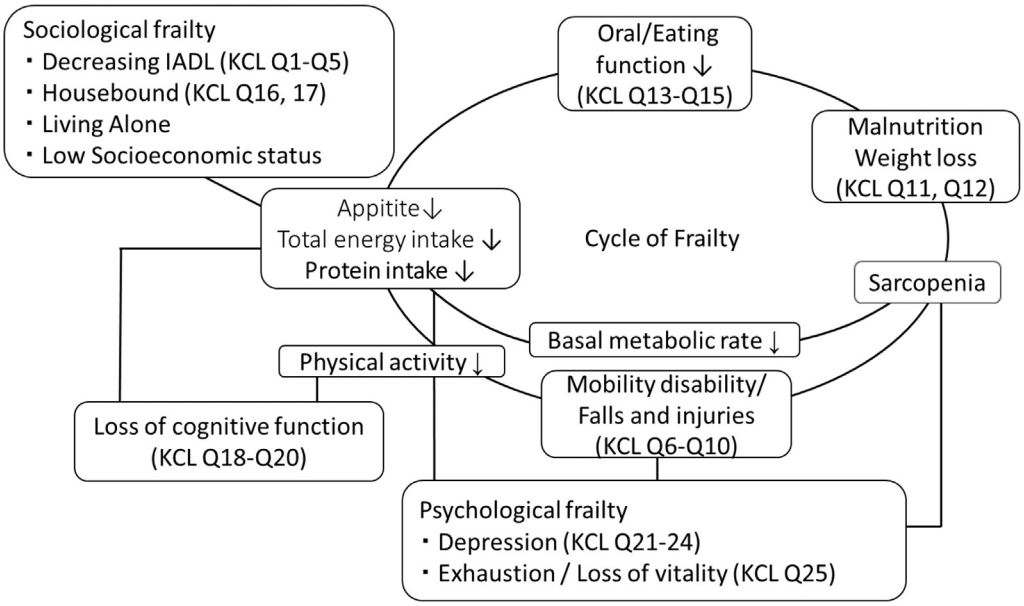

Fig. 1. Schematic diagram of the cycle of frailty by the KCL (based on Fried et al[1] and Xue et al[3]) and its relationship to protein intake. IADL, instrumental activities of daily living.