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分担報告書

「日本人の食事摂取基準」を活用した食事のガイドの作成に資する研究

食事ガイドのためのレビューによる食品および関連因子の同定：高齢者に関する報告

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【研究要旨】

健康日本 21（第二次）最終評価で課題となった高齢者の低栄養に資する食事ガイド作成の資料とするため、本分担課題では、高齢者の低栄養に影響する因子に関連する食事摂取の特徴を把握するための文献レビューを行った。

高齢者は一般的に、身体的、社会的、精神心理的、行動的な制限により食事摂取量が減少するが、これらの制限に起因する食物および栄養素摂取の特徴は十分に体系化されていない。しかし、高齢者の栄養ケア戦略の検討には、実践に向けて知識を体系化することが必要であるため、これらの要因に応じた食物および栄養素摂取の特徴を明らかにすることを目的とした。

先行研究をもとに高齢者の低栄養に関連する因子（身体的・社会的・精神心理的・行動的要因）を選定し、65 歳以上の地域在住高齢者を対象に、これらの因子の有無における食事摂取の特徴を把握することを目的に実施された過去 5 年間の観察研究を質的にレビューした（PROSPERO: CRD42024582151）。PRISMA ガイドラインを遵守し、検索は MEDLINE、Web of Science を使用し、文献スクリーニングは 2 名の研究者が独立して行い、採否の対立時は相談して決定した。対象者に 65 歳未満を含む場合でも、65 歳以上で層化した分析結果があればレビューに含めた。

検索の結果 2,554 件の文献が抽出され、最終的に 29 件が包含基準を満たし、レビューの対象となった。これら 29 件の文献では、身体的要因（口腔機能と身体活動）、社会的要因（経済状況、婚姻状況、世帯人員、学歴）、精神心理的要因（抑うつ）、行動的要因（食料安全保障、栄養知識、調理スキル）が説明変数として扱われていた。質的レビューの結果、口腔機能の低下は、肉、魚、豆類、野菜、果物の摂取量の減少と関連していた。経済状況の低さと学歴の低さは、食生活の質の低さと関連していた。しかし、調理スキルの低さや味覚・嗅覚の低下など、その他の要因を持つ個人の食事摂取量を特徴づけた研究は限られており、さらなる研究の必要性が示唆された。

A. 背景と目的

本分担課題では、健康日本 21(第三次)において目指す食生活に関連する目標の到達に向けて国民の行動変容を促す実装までを見据え、第二次最終評価で課題となった、高齢者の低栄養に資する食事ガイド作成の資料とするため、高齢者の低栄養に影響する因子を抽出し、それに関連する食事摂取の特徴を把握することを目的とした文献レビューを行うこととした。

B. 方法

高齢者の低栄養に関連する因子について、先行研究[1, 2]をもとに選定し、これらの因子(身体的要因、社会・環境的要因、精神・心理的要因、行動的要因)の有無における食事摂取の特徴を把握するため、65 歳以上の地域在住高齢者を対象に実施された過去 5 年間の観察研究を質的にレビューした。文献レビューは PRISMA ガイドラインに準じて行い、プロトコルは PROSPERO(No. CRD42024582151)に登録した。文献検索に用いた式を**表1**に示す。

データベースは MEDLINE、Web of Science を使用した。文献スクリーニングは、一次スクリーニング、二次スクリーニングともに、2 名の研究者が独立して行い、採否の判断が分かれた場合は相談して決定した。なお、対象者に 65 歳未満を含んでいる文献でも、65 歳以上に層化した分析が行われている場合はレビューの対象に含めた。各研究の質評価は、縦断研究は Newcastle Ottawa Scale を、横断研究は Appraisal for Cross-Sectional Studies を用いて実施した。

C. 結果

検索の結果、2,354 件の文献が抽出された。そのうち 382 件が重複のため除外され、1,972 件が一次スクリーニングの対象となった。タイトルと要旨の内容からレビューの目的に合致しない 1,845 件の文献が除外された。二次スクリーニングを経て最終的に 29 件の文献[3-31]が包含基準を満たし、レビューの対象として含められた(**図1**)。そのうち 25 件が横断研究[3-27]、4 件が縦断研究であった[38-31]。

表 2 に包含基準を満たした 29 件の文献の概要をまとめた。検索式には嗅覚・味覚低下も含まれていたが、これらを説明変数に食事摂取量を比較した文献は抽出されなかった。認知機能についても目的変数としたものが多く、認知機能低下の有無で食事摂取を比較した文献は抽出されなかった。栄養知識、調理スキルを扱った文献も非常に限られていた。

表 3 に縦断研究の質評価の結果を、**表 4** に横断研究の質評価の結果を示した。4 件の縦断研究ではいずれもバイアスリスクは低く、研究の質は高いと評価された。横断研究の質は、25 件のうち 5 件が中度、2 件が低度であり、28%の文献でバイアスリスクが中～高を示した。

D. 考察

身体的要因として主に口腔機能に焦点を当てた研究が多く抽出され、口腔機能の低下は、歯の本数、咬合力、口腔立体認知能などで評価され、たんぱく質の豊富な肉、魚、豆類や、微量栄養素が豊富な野菜、果物の摂取量の低値と関連していた。以前の介入研究において、口腔機能が低下した者に対する食事指導は栄養摂取量を改善することが示されており[32,33]、本レビューの結果からも、口腔機能の低下で摂取量が減少しやすいこれらの食品の咀嚼に配慮した調理法などの指導に役立つ可能性が示唆された。

経済状況の違いによる食品や栄養素の摂取量の違いを検討した文献はなく、すべて食事の質との関連を検討しており、その 75%は、経済状況と食事の質に正の関連を報告した。一方、25%は関連がなかったことを方向しており、その理由として、低い経済状況でも食料が入手しやすい環境では食事の質に影響がないことが示唆されており[18]、経済的に恵まれない高齢者でも入手しやすい食品を用いた食事の質向上のための支援が重要な可能性が考えられた。

婚姻状況や世帯人数（例：独居など）と食事の質や摂取量との関連は一貫しておらず、性別、調理技術、栄養知識などの違いに起因する可能性があり[34]、これらの要因を考慮したさらなる研究の必要性が示唆された。

教育歴については、すべての研究が低い教育水準と食事の質の低さに関連があることを報告した。しかし、特定の食品群との関連を検討した文献は乏しく、教育水準が低いと摂取量が影響されやすい食品の特定にはいたらなかったが、高齢者に対する栄養教育介入は、野菜、果物、食物繊維の摂取量を増加させることを示した先行研究があり[35]、教育水準の低い高齢者への栄養教育の必要性を示唆している。

うつ状態は食事の質の低さ、野菜や肉類の摂取量の減少、乳製品や菓子類の摂取量の増加との関連が報告されていた。うつ症状は高齢者の食欲低下を引き起こすことや[36,37]、高齢者は食品選択において嗜好や感覚的な魅力を優先する傾向があることを示す先行研究があり[38]、うつ治療と並行して食欲を刺激する介入や食品選択の教育的支援が重要な可能性がある。

フードインセキュリティ（食料の入手しにくさ)、低い調理スキル、栄養学的知識の乏しさなどは食事摂取に影響しうる重要な制約要因であるものの、これらの要因による食事摂取の特徴を検討した研

究はほとんどなく、栄養学知識や調理スキルを評価する標準化された指標も存在しなかった。この分野での研究の必要性が示唆された。

E. 結論

本研究の知見は、高齢者向けの支援策や教育プログラムの開発に役立つ可能性があるが、同時に、複数の制限要因に関連する食事摂取特性に関する研究の大きなギャップも浮き彫りにした。

F. 健康危険情報

なし

G. 研究発表

1. 論文発表

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2. 学会発表

なし

H. 知的所有権の出願・登録状況

1. 特許取得

なし

2. 実用新案登録

なし

3. その他

なし

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表 1　文献レビューに用いた検索式(MEDLINE)

	検索式
対象者	(“aged”[MeSH Terms] OR ″older adults″ OR ″older people″ OR ″older person″ OR ″elderly″ OR ″senior″)
暴露変数	(“oral health”[MeSH Terms] OR ″oral problem″ OR ″oral condition″ OR ″oral frail″ OR ″oral dysfunction″ OR ″tooth loss″[MeSH Terms] OR “swallowing disorder” OR ″chewing problem″) OR (“loss of taste” OR “taste loss” OR “taste disorder”) OR (“loss of smell” OR “smell loss” OR “hyposmia”) OR (“economic status”[MeSH Terms] OR “socioeconomic factors”[MeSH Terms]) OR (“access to healthy foods” [MeSH Terms] OR “food insecurity”[MeSH Terms]) OR (“living alone” OR “home environment”[MeSH Terms] OR “eating alone”) OR (”social participation”[MeSH Terms] OR “social support”[MeSH Terms] OR “social isolation”[MeSH Terms] OR “meals on wheels” OR “home helper”) OR (“depression”[MeSH Terms] OR “cognitive function”) OR (“cooking skill” OR “nutrition knowledge” OR “food selection” OR “food preferences”[MeSH Terms])
結果変数	(”eating”[MeSH Terms] OR “diet”[MeSH Terms] OR ″food″ OR ″nutrients″ OR ″diet″ OR ″meal″ OR ″dietary intake″ OR ″diet quality″)
研究デザイン	(“observational stud*”[TIAB] OR “cohort stud*”[TIAB] OR “follow-up stud*”[TIAB] OR “epidemiologic stud*”[TIAB] OR “prospective stud*”[TIAB] OR “retrospective stud*”[TIAB] OR “longitudinal stud*”[TIAB] OR “cross-sectional stud*”[TIAB])
言語	(″English″[Language] OR ″Japanese″[Language])
検索期間	(2019/06/01:2024/06/01[Date - Publication])

表2 レビューに含まれた文献の概要

Author, year of publication	Exposure	Outcome (foods/nutrients/quality)	Study design	Country	Sample size, (males %)	Participant age (years)	Results	Covariates
Physical factors								
Iwasaki et al., 2024 [18]	Number of functional teeth	DII	Cross-sectional	Japan	2407 (43.7)	45–98	In participants aged ≥75 years, a higher number of functional teeth is associated with a lower DII (i.e., diet with greater anti-inflammatory potential; β=-0.94, 95% CI=-0.171, -0.018).	Age, sex, occupation type, smoking status, alcohol consumption, exercise status, BMI, hypertension, diabetes, and number of natural teeth.
Iwasaki et al., 2024 [18]	FTUs	DII	Cross-sectional	Japan	2407 (43.7)	45–98	In participants aged ≥75 years, a higher number of FTUs is associated with a lower DII (i.e., diet with greater anti-inflammatory potential; β=-0.094, 95% CI=-0.17, -0.017).	Age, sex, occupation type, smoking status, alcohol consumption, exercise status, BMI, hypertension, diabetes, and number of natural teeth.
Milledge et al., 2021 [19]	FTUs	Achievement of recommended NRV values for total energy and macronutrients and micronutrients (Na; K; I; P; Ca; Mg; Zn; Fe; dietary folate equivalents; thiamin; niacin; riboflavin; and vitamins A, C, D, and E) is assessed.	Cross-sectional	Australia	608 (0)	78–100	In comparison with the natural FTU only group, the replaced FTU only group is more likely to have poor macronutrient intake (OR: 2.00, 95% CI=1.01, 3.94).	Number of FTUs, age, energy intake, BMI, comorbidity, and post-school education.

Kusama et al., 2023 [20]	Number of teeth with/without dental prostheses	Intake of protein (total, animal, and plant)	Cross-sectional	Japan	2095 (43.9)	≥65	There is no significant difference in total protein intake between participants with ≥20 remaining teeth and those with 10–19 remaining teeth, regardless of whether they have dental prostheses or not (p>0.05). Among those with 0–9 remaining teeth, total protein intake is significantly lower in those without a dental prosthesis (β=-2.31, 95% CI=-3.47, -1.14) than in those with a dental prosthesis (β=-0.47, 95% CI=-0.96, 0.01).	Age, sex, income, education, comorbidities (stroke, diabetes, cancer), housing damage, living arrangement, marital status, ADL, smoking status, and alcohol consumption.
Kida et al., 2023 [21]	Number of teeth	Intakes of protein, fat, saturated fatty acid, carbohydrates, n-3 fatty acids, n-6 fatty acids, total dietary fiber, potassium, calcium, iron, vitamin C, and folic acid	Cross-sectional	Japan	238 (34.5)	≥20	Saturated fatty acid intake is increased in those with fewer teeth (β=-0.148, p=0.043).	Sex, age, and meal sequence (eating meals in the order of "vegetable dishes," "meat and fish dishes," and "staple foods").
Shen et al., 2023 [22]	Number of teeth	DDS, intake frequency of foods (fresh fruits, fresh vegetables, meat, fish and aquatic products, eggs, legumes, preserved vegetables, sugar and sweets, tea, and garlic)	Cross-sectional	China	54796 (41.2)	87.9±11.5	Participants with <20 natural teeth have lower DDSs than those with ≥20 natural teeth (edentulous: β=-0.39, 95% CI=-0.48, -0.30; 1–9 teeth: β=-0.46, 95% CI=-0.55, -0.37; 10–19 teeth: β=-0.36, 95% CI=-0.46, -0.26). For individual food items, edentulous, 1–9 natural teeth, and 10–19 natural teeth are associated with lower odds of regular intakes of fresh fruits, fresh vegetables, meat, fish and aquatic products, eggs, legumes, preserved vegetables, tea, and garlic but higher odds of regular intakes of sugar and sweets.	Cohort, age, sex, ethnicity, level of education, type of residence, married status, income level, smoking status, alcohol intake, regular exercise, and BMI.

Gaewkhiew et al., 2021 [23]	FD	Twelve-month changes in three dietary patterns—healthy, meat-rich, and carbohydrate-rich—are analyzed based on factor loadings of key food groups	Longitudinal	Thailand	651 (27.3)	≥60	In comparison with those with neither FD nor dentures, participants with FD (containing ≥10 occlusal contacts) have larger increases in healthy (β=0.13; 95% CI: -0.13, 0.39) and carbohydrate-rich diet intake (β=0.12; 95% CI: -0.17, 0.40) and larger reductions in meat-rich diet intake (β=-0.12; 95% CI=-0.45, 0.21). However, the differences are not significant.	Baseline age groups, sex, residence area, education, wealth quartiles, smoking status, physical activity, hypertension, hyperlipidemia, diabetes, medications, total energy intake, and dietary pattern score.
Gaewkhiew et al., 2019 [23]	FD with/without dentures	Intakes of energy; carbohydrate; fat; protein; saturated fat; cholesterol; crude fiber; dietary fiber; calcium; iron; and vitamins A, B1, B2, B3, B6, B12, C, and E	Cross-sectional	Thailand	788 (30.0)	60–96	Participants with functional dentition have significantly greater intakes of dietary fiber (β=2.69, 95% CI=0.02, 5.37) and vitamin B1 (β=0.66, 95% CI=0.03, 1.29) than those with neither functional dentition nor dentures.	Age, sex, residence area, education, wealth tertiles, physical activity, hypertension, hyperlipidemia, diabetes, and energy intake.
Lin et al., 2021 [24]	Number of POSAs	Intakes of fruits (5 groups), seafoods and meats (4 groups), vegetables (5 groups)	Cross-sectional	Taiwan	1100 (28.6)	≥65	The greater the reduction in POSAs, the higher the odds ratio for a reduction in the number of “able to eat” fruits (≤3 groups), seafood and meat (≤2 groups), and vegetables (≤4 groups) consumed.	Sex, age, educational level, number of natural teeth, and removable denture (full or partial).
Lin et al., 2021 [24]	Number of natural teeth	Able to eat fruits (5 foods), seafoods and meats (4 foods), vegetables (5 foods)	Cross-sectional	Taiwan	1100 (28.6)	≥65	In comparison with participants with ≥20 natural teeth, those with <20 natural teeth have a lower number of “able to eat” vegetables (≤4 groups) consumed (OR=2.8, 95% CI=1.44, 5.31).	Sex, age, educational level, POSA (categories by Eichner index), removable denture (full or partial).
Lin et al., 2021 [24]	Removable denture use	Intakes of fruits (5 foods), seafoods and meats (4 foods), vegetables (5 foods)	Cross-sectional	Taiwan	1100 (28.6)	≥65	Removable denture use is not associated with food intake.	Sex, age, educational level, POSA (categories by Eichner index), and number of natural teeth.

Fukutake et al., 2019 [25]	Occlusal force	Intakes of foods (green and yellow vegetables, other vegetables, fruits, fish and shellfish, meats) and nutrients (protein; carbohydrate; and vitamins A, B2, C, α-tocopherol, dietary fiber, folate, n-3 fatty acids, and n-6 fatty acids)	Cross-sectional	Japan	124 (48.2)	69–81	Occlusal force is positively associated with intakes of fish and shellfish (β=0.188, p=0.026).	Age, sex, educational level, self-assessed financial status, and OSA score.
Fukutake et al., 2019 [25]	OSA	Intakes of foods (green and yellow vegetables, other vegetables, fruits, fish and shellfish, meats) and nutrients (protein; carbohydrate; and vitamins A, B2, C, α-tocopherol, dietary fiber, folate, n-3 fatty acids, and n-6 fatty acids)	Cross-sectional	Japan	124 (48.2)	69–81	OSA score is positively associated with intakes of green and yellow vegetables (β=0.160, p=0.031) and α-tocopherol (β=0.161, p=0.031).	Age, sex, educational level, and self-assessed financial status.
Karawekpanyawong et al., 2023 [26]	Masticatory performance	Intakes of energy; protein; carbohydrate; fat; dietary fiber; calcium; and vitamins D, A, C, E, B1, B2, B3, B5, B6, B12, K, γ-tocopherol, zinc, folic acid, iron, β-carotene, n-3 fatty acids, and n-6 fatty acids	Cross-sectional	Japan	84 (46.4)	90	Participants with masticatory performance <173 mg/dL have lower intakes of folic acid and vitamin A than those with masticatory performance ≥173 mg/dL (β=1.500, 95% CI=0.329, 2.670).	Sex, education, higher-level functional capacity, and BMI (≤20 kg/m²).

Karawekpanyawong et al., 2023 [26]	SSFR	Intakes of energy; protein; carbohydrate; fat; dietary fiber; calcium; and vitamins D, A, C, E, B1, B2, B3, B5, B6, B12, K, γ-tocopherol, zinc, folic acid, iron, β-carotene, n-3 fatty acids, and n-6 fatty acids	Cross-sectional	Japan	84 (46.4)	90	SSFR is positively associated with the intakes of vitamins A (β=40.451, 95% CI=6.891, 74.011), B2 (β=0.025, 95% CI=0.004, 0.046), γ-tocopherol (β=0.225, 95% CI=0.048, 0.402), and n-6 fatty acids (β=0.126, 95% CI=0.021, 0.231) and negatively with the intake of carbohydrate (β=-1.140, 95% CI=-1.875, -0.404).	Sex, education, higher-level functional capacity, and BMI (≤20 kg/m²).
Karawekpanyawong et al., 2023 [26]	Number of teeth	Intakes of energy; protein; carbohydrate; fat; dietary fiber; calcium; and vitamins D, A, C, E, B1, B2, B3, B5, B6, B12, K, γ-tocopherol, zinc, folic acid, iron, β-carotene, n-3 fatty acids, n-6 fatty acids	Cross-sectional	Japan	84 (46.4)	90	The number of teeth is positively associated with the intakes of calcium (β=3.284, 95% CI=0.418, 6.150), folic acid (β=2.514, 95% CI=0.909, 4.118), β-carotene (β=39.268, 95% CI=6.304, 72.232), vitamin C (β=0.866, 95% CI=0.132, 1.601), and vitamin K (β=2.027, 95% CI=0.206, 3.848).	Sex, education, higher-level functional capacity, and BMI (≤20 kg/m²).
Kimble et al., 2023 [27]	Dental status and oral health problems (combined)	EDI or HEI	Cross-sectional	UK and USA	UK, 855 (100); USA, 1970 (50)	UK, 78–98; USA, 70–79	Combined measure of dental status and oral health is not associated with diet quality.	UK cohort: age, social class, smoking status, moderate/heavy drinking, low physical activity, and history of cardiovascular disease and diabetes. USA cohort: age, sex, race, level of education, smoking status, low physical activity, and history of cardiovascular disease and diabetes.

Abe et al., 2022 [42]	Social participation (activity)	DVS	Longitudinal	Japan	6168 (49.3)	65–84	Participation in sports groups and hobby groups is associated with a lower RR of unfavorable eating habits (sports groups: RR=0.95, 95% CI=0.90, 1.00; hobby groups: RR=0.93, 95% CI=0.90, 0.97).	Age, sex, living situation (with others or alone), marital status, duration of residence, and social participation (volunteer, sports, hobby groups, senior citizen club, neighborhood association).
Social factors								
Vaudin et al., 2021 [28]	Household food expenditure	HEI-2010	Cross-sectional	USA	3056 (49.2)	≥60	Food expenditure (money spent on food per household member in last 30 days on special diet) is associated with diet quality (β=5.4, 95% CI=2.4, 8.5 in males; β=3.4, 95% CI=1.1, 5.7 in females).	Age, race/ethnicity, education, marital status, household size, self-reported health, household food security, and nutrition awareness/use.
Teixeira et al., 2019 [29]	Household income	MDP	Cross-sectional	Portugal	1407 (42.5)	≥65	Household income is not associated with the MDP.	Sex, age, regional area, education, marital status, and residence.
Silva et al., 2019 [30]	Per capita family income in minimum wages	Intake of dietary fibers	Cross-sectional	Brazil	1509 (40.5)	≥60	Higher family income (1–2 and >2 minimum wages) is associated with inadequate dietary fiber consumption (1–2: PR=0.95, p=0.017; >2: PR=0.93, p=0.002).	Sex, age, marital status, number of chronic diseases, physical activity, smoking status, desire to change weight, and sleep hours/day.
Kurotani et al., 2020 [31]	Household income	Japanese Food Guide Spinning Top scores	Cross-sectional	Japan	6000 (46.4)	≥20	In participants aged ≥60 years, the higher the household income, the higher the diet quality score (low income: 47.0, 95% CI=45.9, 48.0; middle income: 48.8, 95% CI=48.2, 49.4; high income: 49.3, 95% CI=48.1, 50.4, p=0.004 for trend in males; low income: 50.6, 95% CI=49.7, 51.6; middle income: 51.7, 95% CI=51.1, 52.3; high income: 51.2, 95% CI=50.0, 52.3, p=0.020 for trend in females).	Residential block, population size, household size, children under 15 years, occupation, BMI, smoking, and physical activity.

Yu et al., 2022 [44]	Family income	DDS	Longitudinal	China	13728 (48.3)	65-105	Family income is positively associated with DDS (β=0.2917, p<0.001 in urban area; β=0.2421, p<0.001 in rural area).	Education (literacy/illiteracy), perceived income, residence, age, cohort, sex, marital status, former occupation, multimorbidity, and self-reported health.
Segura-Badilla et al., 2021 [32]	Socioeconomic status	HEI-2010	Cross-sectional	Chile	364 (18.4)	≥60	Socioeconomic status is not associated with decreased quality of diet.	Sex, age, BMI, waist circumference, cardiovascular risk, food safety scale, obesity (BMI ≥30), food insecurity, sleep hours, and physical activity.
Chalermsri et al., 2022 [33]	Economic status	DDS	Cross-sectional	Thailand	7300 (44.1)	≥60	Economic status is associated with DDS (reference group, poorest; poor: β=0.97, 95% CI=0.70, 1.24; average: β=0.30, 95% CI=0.06, 0.54; rich: β=0.56, 95% CI=0.32, 0.80; richest: β=0.81, 95% CI=0.55, 1.06).	Age, sex, educational level, living alone, and residential area.
Yu et al., 2022 [44]	Perceived income status	DDS	Longitudinal	China	13728 (48.3)	65–105	Perceived income status is positively associated with DDS (β=0.2638, p<0.001 in urban area; β=0.4063, p<0.001 in rural area).	Education (literacy/illiteracy), family income, residence, age, cohort, sex, marital status, former occupation, multimorbidity, and self-reported health.
Nishinakagawa et al., 2023 [34]	SFS	Balanced meal consumption	Cross-sectional	Japan	8468 (43.3)	40–97	In older adults, poor SFS is positively associated with balanced meal consumption (PR=1.24, 95% CI=1.09, 1.43).	Sex, age, living arrangement, educational attainment, marital status, current work status, number of comorbidities, 6-item KPDS, and IADL.

Nishinakagawa et al., 2023 [34]	SFS × education (interaction)	Balanced meal consumption	Cross-sectional	Japan	8468 (43.3)	40–97	In older adults, there is an interactive effect of education and SFS on a low frequency of balanced meal consumption ($p<0.001$).	Sex, age, living arrangement, educational attainment, SFS, marital status, current work status, number of comorbidities, 6-item KPDS, and IADL.
Vaudin et al., 2021 [28]	Marital status	HEI-2010	Cross-sectional	USA	3056 (49.2)	≥60	Marital status is not associated with diet quality.	Age, race/ethnicity, education, household size, self-reported health, food expenditure, nutrition awareness/use, and food security.
Teixeira et al., 2019 [29]	Marital status	MDP	Cross-sectional	Portugal	1407 (42.5)	≥65	Marital status (married or common-law marriage) is related with increased odds of adherence to the MDP (OR=1.54, 95% CI=1.20, 1.97).	Sex, age, regional area, education, household income, and residence.
Silva et al., 2019 [30]	Marital status	Intake of dietary fibers	Cross-sectional	Brazil	1509 (40.5)	≥60	Marital status (with partner) is associated with inadequate dietary fiber consumption (PR=1.07, p=0.002).	Sex, age, income, number of chronic diseases, physical activity, smoking, desire to change weight, and sleep hours/day.
Evedove et al., 2020 [35]	Marital status	Irregular consumption of fruits and/or vegetables and legumes (i.e., ≤4 days/week)	Cross-sectional	Brazil	11185 (100)	≥60	There is no association between marital status and irregular consumption of fruits and/or vegetables.	Educational level, age group, and race/skin color.
Son et al., 2019 [36]	Living alone and eating alone (combined)	Intakes of energy and nutrients (carbohydrate, protein, lipids)	Cross-sectional	South Korea	16015 (not stated	≥19	Among older adults, none of the dietary factors differ significantly by living arrangements and eating behavior.	Age, sex, income, education, smoking, alcohol consumption, and physical activity.

Laursen et al., 2019 [42]	Household composition	Intakes of fish, red meat, and fruits/vegetables	Cross-sectional	Denmark	85456 (45.2)	≥25	Older males living with others have significantly higher intakes of fish, red meat, and fruits/vegetables than participants living alone. Older females living with others have significantly higher intakes of fish and red meat than participants living alone.	Educational level and age.
Chalermsri et al., 2022 [33]	Household composition	DDS	Cross-sectional	Thailand	7300 (44.1)	≥60	Living alone is negatively associated with DDS (β=-0.27, 95% CI=-0.53, 0.00, p=0.049).	Age, sex, educational level, wealth index, and residential area.
Vaudin et al., 2021 [28]	Educational level	HEI-2010	Cross-sectional	USA	3056 (49.2)	≥60	Education status (some college/college+) is associated with diet quality in males (β=5.3, 95% CI=3.0, 7.6) and females (β=2.1, 95% CI=0.2, 4.0).	Age, race/ethnicity, marital status, household size, self-reported health, food expenditure, nutrition awareness/use, and food security.
Teixeira et al., 2019 [29]	Educational level	MDP	Cross-sectional	Portugal	1407 (42.5)	≥65	Higher educational level (≥5 years) is associated with increased odds of adherence to the MDP (OR=2.38, 95% CI=1.54, 3.69).	Sex, age, regional area, marital status, household income, and residence.

Hashimoto et al., 2021 [37]	Educational level	Japanese Food Guide Spinning Top scores	Cross-sectional	Japan	5976 (0)	34–94	The mean diet quality score is higher in participants with high or middle education than in those with low education (low education: mean=49.8, 95% CI=49.3, 50.3; middle education: mean=50.8, 95% CI=50.3, 51.3; high education: mean=52.2, 95% CI=51.1, 53.2). In comparison with those with low education, participants with high and middle education had better scores of “sodium from seasonings” (low education: mean=5.8, 95% CI=5.7, 6.0; middle education: mean=6.1, 95% CI=6.0, 6.3; high education: mean=7.0, 95% CI=6.7, 7.4) and “fruits” (low education: mean=5.0, 95% CI=4.8, 5.2; middle education: mean=5.4, 95% CI=5.2, 5.6; high education: mean=6.0, 95% CI=5.6, 6.4).	Age, BMI, living status, marital status, smoking, physical activity, prescription medication, diet cost, urban-rural classification, primary sector employment %, areal deprivation index, number of food retailers, and region.
Chalermsri et al., 2022 [33]	Educational level	DDS	Cross-sectional	Thailand	7300 (44.1)	≥60	Educational level is positively associated with DDS (primary education: β=0.76, 95% CI=0.52, 1.03; secondary or higher education: β=1.37, 95% CI 1.04, 1.70).	Age, sex, living alone or not, wealth index, and residential area.
Nishinakagawa et al., 2023 [34]	Educational level	Balanced meal consumption	Cross-sectional	Japan	8468 (43.3)	40–97	In older adults, lower educational attainment is positively associated with a low frequency of balanced meal consumption (PR=1.14, 95% CI=1.00, 1.30).	Sex, age, living arrangement, subjective financial status, marital status, current work status, number of comorbidities, 6-item KPDS, and IADL.
Yu et al., 2022 [44]	Literacy	DDS	Longitudinal	China	13728 (48.3)	65–105	Literacy (vs. illiteracy) is positively associated with DDS (β=0.1645, p=0.0003 in urban area; β=0.0932, p=0.0080 in rural area).	Family income, perceived income, residence, age, cohort, sex, marital status, former occupation, multimorbidity, and self-reported health.

Psychological factors

Elstgeest et al., 2019A [38]	Depressive symptoms (current, chronic, and history)	MDS, AHEI-2010, and DASH	Cross-sectional	Netherlands	1312 (48.1)	Median 65.1	In males, current depressive symptoms (CES-D≥16) are associated with lower MDS (β=-1.21, 95% CI=-2.41, -0.02) and AHEI (β=-2.72, 95% CI=-5.24, -0.20) scores. Chronic depressive symptoms (CES-D ≥16 in 2011–2013 and 2015/2016 versions) are associated with lower MDS scores (β=-2.22, 95% CI=-3.40, -1.04) and a trend for lower AHEI scores (β=-2.37, 95% CI=-4.92, 0.18). In males, history of depressive symptoms (ever CES-D ≥16 from 2001–2003 to 2011–2013) is associated with lower MDS (β=-1.87, 95% CI=-3.47, -0.27) and AHEI (β=-4.33, 95% CI=-7.54, -1.13) scores.	Age, cohort, educational level, marital status, physical activity, smoking, and number of chronic diseases.
Elstgeest et al., 2019B [45]	Depressive symptoms	Intake of foods (vegetables, nuts and legumes, potatoes, dairy products, fish and shellfish, sweet foods, coffee and tea, wholegrain bread, savory snacks, and sugar-sweetened beverages and fruits juices)	Longitudinal	Italy	1058 (45.3)	20–102	Higher CES-D scores are associated with decreases in intakes of vegetables (% of change in the follow-up=0.995, 95% CI=0.990, 0.999) and red and processed meat (β=-0.006, 95% CI=-0.010, -0.001), increases in dairy product intake (% of change in the follow-up=1.008, 95% CI=1.004, 1.013), and increased odds of eating savory snacks (OR: 1.012, 95% CI=1.000, 1.024).	Baseline food group intake, age, sex, marital status, educational level, physical activity, smoking, IADL disabilities, alcohol intake, and number of chronic diseases.
Behavioral factors								
Pourebrahim et al., 2024 [39]	Food security status	DDS	Cross-sectional	Iran	583 (47.9)	60–80	There is no association between food insecurity and DDS.	Age, sex, household income per month, educational level, employment status, living arrangement, and residential area.

Segura-Badilla et al., 2021 [32]	Food security status	HEI-2010	Cross-sectional	Chile	364 (18.4)	≥60	Food insecurity is not associated with decreased quality of diet.	Sex, age, BMI, waist circumference, cardiovascular risk, food safety scale, socioeconomic status (vulnerable/poor), obesity (BMI ≥30), sleep hours, and physical activity.
Odunitan-Wayas et al., 2021 [40]	Food security status	Intakes of energy, nutrients (protein, total fat, total carbohydrate), and foods (fruits, vegetables, cooked porridge, starchy grains, legumes, nuts and seeds, milk and dairy products, animal protein foods, sugar and sugary foods, fats and oils, savory snacks, dished and sauces, alcohol)	Cross-sectional	South Africa	122 (0)	60–85	For nutrient intake (% of total energy from macronutrients), participants with food security have higher fat intake and lower carbohydrate intake than those with food insecurity (fat intake: 23.5% energy vs. 19.0% energy, p=0.003; carbohydrate intake: 63.2% energy vs. 67.8% energy, p=0.013). For food intake (% of total energy from foods), participants with food security have lower legume intake (1.4 vs. 2.1, p=0.049) and higher fat and oil intake (4.3 vs. 2.3, p=0.023) than those with food insecurity.	None.
Vaudin et al., 2021 [28]	Food security status	HEI-2010	Cross-sectional	USA	3056 (49.2)	≥60	Household food security (full food security) is associated with diet quality in females (β=4.0, 95% CI=1.4, 6.6).	Age, race/ethnicity, education, marital status, household size, self-reported health, food expenditure, and nutrition awareness/use.
Vaudin et al., 2021 [28]	Nutrition awareness and information use	HEI-2010	Cross-sectional	USA	3056 (49.2)	≥60	Nutrition awareness and nutrition information use are associated with diet quality in males (β=6.0, 95% CI=0.7, 11.4) and females (β=4.2, 95% CI=1.6, 6.8).	Age, race/ethnicity, education, marital status, household size, self-reported health, food expenditure, and nutrition awareness/use.
Tani et al., 2020 [41]	Cooking skill	Frequency of vegetable and fruit intakes	Cross-sectional	Japan	19378 (47.2)	≥65	In females, participants with moderate to low level of cooking skills have lower frequency of vegetable and fruit intake	Age, education, annual normalized household income, marital status, and

		than those with high level of cooking skills (PR=1.61, 95% CI=1.36, 1.91).	medical treatment (cancer, heart disease, stroke, diabetes, hypertension, and hyperlipidemia).

表 3 レビューされた縦断研究の Newcastle–Ottawa Scale による質評価の結果

Authors, year of publication	Selection				Comparability	Outcome			Total score	Study quality
	1	2	3	4	5	6	7	8		
Abe et al., 2022 [43]	*	*		*	**		*	*	7	High
Gaewkhiew et al., 2021 [44]	*	*	*	*	**		*	*	8	High
Yu et al., 2022 [45]	*	*	*	*	**		*	*	8	High
Elstgeest et al., 2019 [46]	*	*	*	*	**		*	*	8	High

1) Representativeness of the exposed cohort
2) Selection of the non-exposed cohort
3) Ascertainment of exposure
4) Demonstration that the outcome of interest was not present at the start of the study
5) Comparability of cohorts on the basis of the design or analysis controls for confounders
6) Assessment of outcome
7) Was the follow-up long enough for outcomes to occur
8) Adequacy of follow-up of cohorts

表 4 レビューされた横断研究の Appraisal tool for Cross-Sectional Studies による質評価の結果

	Introduction	Methods										Results					Discussion		Other			
Authors, year of publication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total score	Study quality
Iwasaki et al., 2024 [18]	Y	Y	N	Y	Y	Y	P	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	16	H
Milledge et al., 2021 [19]	Y	Y	N	Y	Y	N	P	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	16	H
Kusama et al., 2023 [20]	Y	Y	N	Y	P	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	15	M
Kida et al., 2023 [21]	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	15	M
Shen et al., 2023 [22]	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	17	H
Gaewkhiew et al., 2019 [23]	Y	Y	Y	Y	P	?	N	Y	Y	Y	Y	Y	N	P	Y	Y	Y	Y	Y	Y	15	M
Lin et al., 2021 [24]	Y	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	17	H
Fukutake et al., 2019 [25]	Y	Y	Y	Y	P	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	15	M
Karawekpanyawong et al., 2023 [26]	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	16	H
Kimble et al., 2023 [27]	Y	Y	N	Y	P	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	16	H
Vaudin et al., 2021 [28]	Y	Y	N	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	17	H
Teixeira et al., 2019 [29]	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	18	H
Silva et al., 2019 [30]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	17	H
Kurotani et al., 2020 [31]	Y	Y	N	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	17	H
Segura-Badilla et al., 2021 [32]	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	?	N	Y	Y	Y	Y	Y	Y	16	H
Chalermsri et al., 2022 [33]	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	19	H
Nishinakagawa et al., 2023 [34]	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	17	H
Evedove et al., 2020 [35]	Y	Y	N	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	17	H
Son et al., 2019 [36]	Y	Y	N	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	17	H
Hashimoto et al., 2021 [37]	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	15	M
Elstgeest et al., 2019 [38]	Y	Y	N	Y	P	P	N	Y	Y	Y	Y	Y	P	N	Y	Y	Y	Y	Y	Y	14	L
Pourebrahim et al., 2024 [39]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	18	H
Odunitan-Wayas et al., 2021 [40]	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	?	N	Y	Y	Y	Y	Y	Y	14	L
Tani et al., 2020 [41]	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	17	H
Laursen et al., 2019 [42]	Y	Y	Y	Y	Y	P	P	Y	Y	Y	Y	Y	P	N	Y	Y	Y	Y	Y	Y	16	H

Key symbols: Y=Yes, N=No, P=Partially, ?=No information available to make a decision, H=high, M=moderate, L=low.

1) Were the aims/objectives of the study clear?

2) Was the study design appropriate for the stated aim(s)?

3) Was the sample size justified?

4) Was the target/reference population clearly defined? (Is it clear who the research was about?)

5) Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?

6) Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?
7) Were measures undertaken to address and categorize non-responders?
8) Were the risk factor and outcome variables measured appropriately to the aims of the study?
9) Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialed, piloted, or published previously?
10) Is it clear what was used to determine statistical significance and/or precision estimates (e.g., p-values, confidence intervals)?
11) Were the methods (including statistical methods) sufficiently described to enable them to be repeated?
12) Were the basic data adequately described?
13) Does the response rate raise concerns about non-response bias?
14) If appropriate, was information about non-responders described?
15) Were the results internally consistent?
16) Were the results presented for all the analyses described in the methods?
17) Were the authors' discussions and conclusions justified by the results?
18) Were the limitations of the study discussed?
19) Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?
20) Was ethical approval or consent of participants attained?

図1　文献選択のフローチャート

