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Defecation Frequency, Stool Form, and Comprehensive Frailty in Community-Dwelling Older Adults: A Cross-Sectional Study

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Abstract

Background

Bowel dysfunction may be a modifiable but under-recognized factor related to multidimensional frailty in older adults. Constipation includes distinct features, such as reduced defecation frequency and hard stool, which may reflect different aspects of bowel function. We examined which bowel-related indicator was most consistently associated with comprehensive frailty in community-dwelling older adults.

Methods

This cross-sectional study included 267 community-dwelling older Japanese adults aged 65 years or older living in Settsu City, Osaka, Japan. Constipation was operationally defined as < 3 bowel movements/week and/or Bristol Stool Form Scale types 1–2. Defecation frequency was categorized as ≥ 7, 5–6, and ≤ 4 times/week, and stool form as types 1–2, 3–5, and 6–7. Comprehensive frailty was assessed using the Kihon Checklist. Multivariable logistic regression models were used to estimate odds ratios and 95% confidence intervals for comprehensive frailty according to constipation status, defecation frequency, and stool form. Sensitivity analyses excluded users of antibiotics, laxatives, or bowel-regulating medications, and additional analyses further adjusted for or excluded participants with selected physical, cognitive, or functional impairments.

Results

Lower defecation frequency was associated with higher odds of comprehensive frailty. Compared with ≥ 7 bowel movements/week, multivariable-adjusted odds ratios were 2.46 (95% confidence interval, 1.10–5.55) for 5–6 times/week and 4.27 (1.67–11.1) for ≤ 4 times/week (P for trend < 0.01). After excluding medication users, the association remained evident; the corresponding odds ratio for ≤ 4 times/week was 5.32 (1.74–16.7). The association was generally consistent after additional adjustment for or exclusion of participants with selected impairments. In contrast, constipation status and stool form were not significantly associated with comprehensive frailty after adjustment. Exploratory subdomain analyses suggested associations of lower defecation frequency with oral function/eating and depression/mood problems.

Conclusions

Lower defecation frequency, rather than operationally defined constipation or stool form alone, was associated with comprehensive frailty. Defecation frequency may be a simple bowel-related indicator of multidimensional frailty-related vulnerability in community-dwelling older adults.

Introduction

Frailty is a geriatric syndrome characterized by age-related declines across multiple physiological systems and increased vulnerability to adverse outcomes, including falls, disability, hospitalization, long-term care needs, and mortality [1]. With population aging, the prevention of frailty has become an important public health and geriatric priority [1, 2]. Because frailty is potentially preventable and modifiable, identifying modifiable factors that may contribute to its development and progression is important for maintaining health and independence in older adults [2].

Beyond physical impairment, frailty encompasses nutritional, oral, cognitive, psychological, and social domains [3]. The Kihon Checklist (KCL), a validated screening tool widely used in Japan, captures multidimensional aspects of frailty and is applied in community-based studies [4, 5]. Bowel function is relevant because constipation and reduced defecation frequency are common in older adults [6, 7] and are closely linked to behavioral and physiological frailty-related factors, including dietary and fluid intake, physical activity, gut motility, and gut microbial metabolism [6, 8].

Existing evidence on the association between constipation and frailty in older adults is limited and inconsistent [9–11]. In a study of community-dwelling older adults in Korea, chronic constipation, defined using the Rome-based criteria, was associated with greater frailty [10]. However, in an analysis of older adults from the US National Health and Nutrition Examination Survey, constipation defined by a hard stool form using Bristol Stool Form Scale (BSFS) types 1–2 was associated with frailty in unadjusted analyses, but this association was no longer significant after full adjustment for potential confounders [11]. A study of older outpatients found no significant association between Rome IV-defined functional constipation and frailty assessed using the FRAIL scale [9].

These inconsistent findings may reflect not only different study populations and frailty measures but also different definitions, measurements, and categorizations of bowel dysfunction [9–11]. Constipation is a symptom-based construct that commonly includes reduced defecation frequency and hard stool; both are epidemiological indicators and are incorporated into diagnostic criteria for chronic constipation [8, 12]. However, these indicators may reflect different, albeit related, bowel function aspects. Defecation frequency may reflect habitual bowel rhythm and is influenced by bowel motility, dietary and fluid intake, physical activity, medication use, and toileting habits, whereas stool form may more directly reflect intestinal transit and stool water content [13, 14]. Thus, evaluating constipation as a simple dichotomous condition may obscure which bowel dysfunction components are relevant to frailty [8–12]. Few studies have directly compared constipation status, graded categories of defecation frequency, and stool form within the same analytical framework with respect to comprehensive frailty [9–11].

Therefore, we examined the association of constipation status, graded categories of defecation frequency, and stool form with comprehensive frailty assessed using the KCL among community-dwelling older Japanese adults. By evaluating these bowel-related indicators within the same analytical framework, we sought to clarify which bowel dysfunction component was most consistently associated with multidimensional frailty. Moreover, we explored the associations between bowel-related indicators

and specific KCL subdomains to examine the domains of frailty-related vulnerability that may be particularly related to bowel function.

Methods

Study population

This cross-sectional study was conducted within the framework of the Japan Dementia Early Phase Project (J-DEPP), a nationwide initiative for the early detection of cognitive decline among community-dwelling older adults. In addition to the core J-DEPP assessments, our study independently collected information on physical function, body composition, lifestyle behaviors, dietary intake, and bowel-related factors. Participants were community-dwelling older adults living in Settsu City, Japan. Participants were community-dwelling older adults living in Settsu City, Japan. Residents who were expected to be aged 65 years or older by the end of the Japanese fiscal year were eligible to participate. Individuals who expressed interest contacted the study office and were scheduled for assessment at designated community facilities or the National Institutes of Biomedical Innovation, Health and Nutrition. Eligibility criteria included residence in Settsu City and provision of written informed consent. Participants ranged in age from 64 to 96 years. Participants ranged in age from 64 to 96 years; one participant was aged 64 years at the time of the survey but met the eligibility criteria because they reached 65 years of age by the end of the Japanese fiscal year.

Altogether, 284 participants were enrolled. Participants with missing or invalid data on bowel movement frequency or BSFS scores were excluded (n = 5). We further excluded participants with irritable bowel syndrome (n = 4), ulcerative colitis (n = 1), or implausible energy intake based on sex-specific cutoffs (< 500 or ≥ 3,500 kcal/day for women; <800 or ≥ 4,000 kcal/day for men; n = 7). Ultimately, 267 participants were included in the primary analysis. As the use of antibiotics, laxatives, and bowel-regulating medications may influence bowel status and related outcomes, two analytical approaches were adopted. All eligible participants were included in the primary analysis, and the use of antibiotics, laxatives, and bowel-regulating medications was included as a covariate in the multivariate models. Participants who reported using antibiotics (n = 17), laxatives (n = 35), or bowel-regulating medications (n = 27) were excluded from the sensitivity analysis. Because some participants reported using more than one medication category, 69 unique participants were identified as medication users; participants with missing information on medication use who could not be confirmed as non-users were also excluded from this analysis. Consequently, 191 participants with confirmed non-use of antibiotics, laxatives, and bowel-regulating medications were included in the sensitivity analysis.

This study was approved by the Research Ethics Review Committee of the National Institute of Biomedical Innovation, Health and Nutrition (Approval No. M2024-029-06). All participants provided written informed consent. This study adhered to the principles of the Declaration of Helsinki.

Definition of comprehensive frailty

Comprehensive frailty was assessed using the KCL [3, 4]. It comprises 25 items covering multiple frailty dimensions, including physical, psychological, and social vulnerability. These items are organized into seven domains: instrumental activities of daily living (items 1–5), physical function (6–10), nutritional status (11–12), oral function (13–15), social engagement and homebound status (16–17), cognitive function (18–20), and depressive mood (21–25). Each item was scored 1 when the response indicated a frailty-related problem and 0 otherwise, yielding a total score of 0–25. Higher scores indicate greater frailty. Participants with total KCL scores ≥ 8 were classified as having comprehensive frailty [4]. For exploratory subdomain analyses, we examined six domain-specific impairment criteria commonly used in KCL-based preventive care screening: physical function, nutritional status, oral function, housebound status, cognitive function, and depressive mood. The composite criterion based on items 1–20 was excluded because it represents overall functional impairment rather than a distinct KCL subdomain.

Assessment of stool status and definition of constipation

Habitual stool status was assessed using the “intestinal visible sheet,” a self-reported tool for the multifaceted evaluation of fecal condition [15, 16]. The questionnaire assesses five stool-related characteristics: bowel movement frequency, volume, color, form, and odor [16]. In this study, habitual stool status data were used for all analyses. Bowel movement frequency was recorded using six response categories: ≥7, 6, 5, 4, 3, and ≤ 2 times/week. Stool form was assessed using the BSFS, which classifies the stool form into seven types and reflects intestinal transit and fecal moisture content [13, 15]. For our study, constipation was operationally defined as < 3 bowel movements/week and/or a BSFS type of 1 or 2. These criteria were selected based on two core constipation-related features included in the symptom-based diagnostic criteria: infrequent bowel movements and lumpy or hard stools [12]. Participants who met either of the criteria were classified as having constipation.

Covariates

Covariates included in the multivariate models were sex, age, total energy intake, total dietary fiber intake, alcohol consumption, smoking status, physical activity, long-term care certification status, and histories of diabetes, cardiovascular disease, and cancer. Total energy intake (kcal/day), total dietary fiber intake (g/day), and alcohol consumption (g/day) were estimated using the Brief-type Self-administered Diet History Questionnaire [17]. Smoking status was self-reported and categorized as current, former, or never smoker. Physical activity was measured using a validated waist-worn triaxial accelerometer (HJA-750C Active Style Pro; Omron Healthcare Co., Ltd., Kyoto, Japan) [18]. Participants were instructed to wear the device during waking hours for approximately seven consecutive days, removing it only during bathing or swimming. Long-term care certification status was assessed using a self-reported questionnaire and categorized into three groups reflecting increasing levels of functional dependency: no certification, support required, and care required [19]. Histories of diabetes,

cardiovascular disease, and cancer were assessed using a self-administered questionnaire and categorized as yes or no. The use of antibiotics, laxatives, and bowel-regulating medications at the time of the survey was assessed using a self-administered questionnaire. Use of each medication category was classified as yes or no. These variables were included as covariates in the primary analysis, whereas participants who reported the use of any of these medications were excluded from the sensitivity analysis.

Statistical analysis

Baseline characteristics are summarized overall and according to the comprehensive frailty status. Categorical variables are presented as numbers and percentages and continuous variables as means and standard deviations. Differences between participants with and without comprehensive frailty were assessed using Pearson's chi-squared test for categorical variables and the Wilcoxon rank-sum test for continuous variables.

Logistic regression models were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for comprehensive frailty according to constipation status, defecation frequency, and BSFS category. Separate models were fitted for each bowel-related indicator. Participants without constipation served as the reference group in the constipation analysis. Defecation frequency was collapsed into three ordered categories: ≥7, 5–6, and ≤ 4 times/week, with ≥ 7 times/week as the reference category representing at least daily bowel movements. The ≤ 4 times/week category was used to capture lower-than-daily habitual defecation frequency while maintaining sufficient numbers of participants and events. The threshold of < 3 bowel movements/week was used only for the operational constipation definition, consistent with Rome IV criteria [12]. BSFS types were categorized as 1–2, 3–5, and 6–7 to represent hard, normal/intermediate, and loose stool forms, respectively, based on the established interpretation of the BSFS [13, 14]. Model 1 was unadjusted. In the primary analysis that included all participants, Model 2 was adjusted for sex, age, total energy intake, total dietary fiber intake, smoking status, alcohol intake, daily step counts, long-term care insurance certification status, use of antibiotics, laxatives, and bowel-regulating medications, diabetes, cardiovascular disease, and cancer. The model for defecation frequency was additionally adjusted for BSFS category, and the model for BSFS category was additionally adjusted for defecation frequency category.

To assess the robustness of the findings, sensitivity analyses were conducted after excluding users of antibiotics, laxatives, or bowel-regulating medications. Participants with missing medication use data who could not be confirmed as non-users were also excluded. In the sample without medication, Model 2 was adjusted for sex, age, total energy intake, total dietary fiber intake, smoking status, alcohol intake, daily step counts, long-term care insurance certification status, diabetes, cardiovascular disease, and cancer. The same mutual adjustments between defecation frequency and BSFS category were applied as in the primary analysis. A linear trend across the three defecation frequency categories was assessed by assigning ordinal scores to the categories and entering this variable as a continuous term in the logistic regression model.

To further examine whether the association between defecation frequency and comprehensive frailty could be explained by selected indicators of physical function, physical activity, muscle mass, or cognitive function, we conducted additional sensitivity analyses using two complementary methods. First, the base-adjusted model for defecation frequency was adjusted separately for grip weakness, slow gait speed, impaired standing-up, low moderate-to-vigorous physical activity (MVPA), low muscle mass, and low cognitive function. Second, the same analyses were repeated after excluding participants with corresponding impairments or limitations. Grip weakness and low muscle mass were defined using the Asian Working Group for Sarcopenia 2025 criteria [20]. Grip weakness was defined as handgrip strength < 28 kg in men and < 18 kg in women, and low muscle mass was defined as a height-adjusted skeletal muscle mass index < 7.0 kg/m² in men and < 5.7 kg/m² in women when assessed by bioelectrical impedance analysis. Slow gait speed was defined as a usual gait speed < 1.0 m/s, and impaired chair-stand performance was defined as a five-time chair stand test duration ≥ 12 s. These measures were treated as physical performance indicators rather than diagnostic criteria for sarcopenia. Low MVPA was defined as < 40 min/day, corresponding to the recommendation for older adults to engage in at least 40 min/day of physical activity at an intensity of ≥ 3 METs in the Physical Activity Guide for Health Promotion 2023 [21]. Low cognitive function was defined as a Mini-Mental State Examination score ≤ 27 [22].

To explore which frailty aspects were associated with defecation frequency, additional multivariable logistic regression analyses were performed for KCL subdomain impairments in the full analytical and no-medication samples. These models used the same covariates as the corresponding Model 2 analyses and were additionally adjusted for BSFS category. When sparse data or complete/quasi-complete separation precluded stable model estimation, estimates for the corresponding subdomains were not displayed in the forest plot. Complete-case analyses were conducted separately for each model. All statistical analyses were conducted using the R software (version 4.3.3; R Foundation for Statistical Computing, Vienna, Austria). All tests were two-sided, and P-values < 0.05 were considered statistically significant.

Results

Table 1 shows the participants' characteristics according to their comprehensive frailty status. Of the 267 participants, 199 were classified as non-frail and 68 were classified as frail. Participants with frailty were older and had lower daily step counts than those without frailty. The prevalence of cancer and laxative use was also higher among frail participants. Defecation frequency category differed significantly according to frailty status; participants with frailty had a lower proportion of bowel movements ≥7 times/week and a higher proportion of bowel movements ≤4 times/week than did non-frail participants. In contrast, sex, BMI, energy intake, smoking status, alcohol intake, diabetes, cardiovascular disease, BSFS category, and constipation status did not differ significantly between the two groups.

Table 2 shows the associations of constipation status, defecation frequency, and BSFS categories with comprehensive frailty. Among all participants, constipation status was not significantly associated with frailty in either the crude or multivariable-adjusted model. In contrast, lower defecation frequency was consistently associated with higher frailty odds. Compared with participants reporting ≥7 bowel movements/week, the multivariable-adjusted ORs were 2.46 (95% CI: 1.10–5.55) for 5–6 times/week and 4.27 (95% CI: 1.67–11.1) for ≤4 times/week, with a significant trend across categories (*P* for trend<0.01). BSFS categories were not significantly associated with frailty after multivariate adjustment.

In the sensitivity analysis, excluding participants using antibiotics, laxatives, or bowel-regulating medications, the association between lower defecation frequency and frailty remained evident. Compared with ≥7 times/week, the multivariable-adjusted OR was 5.32 (95% CI: 1.74–16.7) for ≤4 times/week, with a significant trend across categories (*P* for trend<0.01). Constipation status and BSFS categories were not significantly associated with frailty after adjustment in this sensitivity analysis.

Table 3 shows additional sensitivity analyses examining whether the association between defecation frequency and comprehensive frailty was influenced by selected indicators of physical function, physical activity, muscle mass, or cognitive function. The association between lower defecation frequency and higher odds of comprehensive frailty remained generally consistent after further adjustment for, or exclusion of, participants with grip weakness, slow gait speed, stand-up impairment, low MVPA, low muscle mass, or low cognitive function.

Figure 1 shows the associations between defecation frequency and impairment in the analyzable KCL subdomains. Nutritional status impairment was not displayed because stable estimates could not be obtained owing to sparse data. Among all participants, lower defecation frequency showed more evident associations with oral function/eating and depression/mood problems. Compared with ≥7 bowel movements/week, ≤4 bowel movements/week was associated with higher odds of oral function/eating problems (OR, 2.56; 95% CI: 1.03–6.39) and depression/mood problems (OR, 3.15; 95% CI: 1.08–9.25). A positive but imprecise association was also observed for socialization/housebound problems, whereas no clear associations were observed for physical function/strength or cognitive/memory problems. After excluding participants who used antibiotics, laxatives, or bowel-regulating medications, the association with oral function/eating problems remained evident. Lower defecation frequency was also associated with socialization/housebound problems, although the confidence intervals were wide. Suggestive associations were observed for cognitive/memory and depression/mood problems among those reporting ≤4 bowel movements/week.

Discussion

In this cross-sectional study of community-dwelling older adults, a lower defecation frequency showed a graded association with higher comprehensive frailty odds. This association remained evident after excluding users of antibiotics, laxatives, or bowel-regulating medications. However, stool form assessed using BSFS was not associated with frailty after multivariate adjustment. Constipation status was not

significantly associated with frailty in either the crude or multivariable-adjusted model. These findings suggest that defecation frequency, rather than stool form alone or constipation status as a combined indicator, is the bowel-related measure most consistently associated with comprehensive frailty.

Additional sensitivity analyses provided further support for the robustness of the main findings. The association remained generally consistent in analyses that additionally adjusted for, or excluded participants with, selected physical, muscular, cognitive, and functional impairments. These findings suggest that the observed association was not simply attributable to lower physical activity or poorer physical, muscular, or cognitive function. Thus, reduced defecation frequency may be more than a simple marker of established functional decline and may represent a bowel-related component of potentially modifiable pathways underlying multidimensional frailty. Nevertheless, because of the cross-sectional design, these analyses cannot determine whether reduced defecation frequency contributes to frailty, reflects early multidimensional vulnerability, or both.

The present results are broadly consistent with those of previous studies in which the associations of Rome IV-defined functional constipation or hard-stool-defined constipation with frailty were no longer significant after multivariable adjustment [9, 11]. In contrast, a Korean community-based study reported a positive association between Rome-based chronic constipation and frailty burden [10]. Differences in the populations studied, frailty assessment, and constipation definitions may partly explain these divergent findings. Importantly, the graded association observed for defecation frequency in the present study suggests that habitual bowel frequency may provide information that is not fully captured by stool form or by a composite dichotomous definition of constipation.

The stronger and more consistent association observed for defecation frequency than for operationally defined constipation may partly reflect a broader range of potentially modifiable factors related to defecation frequency. Inadequate dietary intake and physical inactivity are established risk factors for frailty [23, 24], which, together with insufficient fluid intake and impaired intestinal motility, have been associated with infrequent bowel movement in older adults [6, 7]. Therefore, reduced defecation frequency may represent one component of a potentially modifiable pathway linking unfavorable dietary, activity-related, and gastrointestinal conditions to frailty, rather than merely serving as a marker of established frailty. Moreover, longer colonic transit has been associated with a shift in microbial metabolism from carbohydrate fermentation to protein catabolism and higher concentrations of potentially detrimental microbial metabolites [8, 25]. Alterations in the gut microbiota and their metabolic functions have also been implicated in frailty and related outcomes [26].

The weak association observed for operationally defined constipation may also be related to how constipation was defined and analyzed. The constipation definition combines very low defecation frequency with hard stool form, although these features represent related but distinct bowel phenotypes [12–14]. Because stool form was not clearly associated with frailty in the present study, combining participants with very low defecation frequency and those with hard stools may have attenuated the association specifically attributable to reduced defecation frequency. Furthermore, the criterion of < 3

bowel movements per week identified a small and relatively restricted subgroup, potentially reducing statistical precision. By contrast, the ≤ 4-times/week category captured a broader spectrum of reduced habitual bowel frequency and was not intended as a diagnostic threshold for constipation. Laxatives and bowel-regulating medications may also have modified the bowel habits observed at the time of assessment because these treatments can increase defecation frequency and alter stool consistency [6, 27]. The stronger association observed after excluding medication users is consistent with this possibility, although the smaller sensitivity-analysis sample warrants cautious interpretation. Longitudinal and interventional studies are, therefore, needed to determine whether maintaining or improving defecation frequency contributes to preventing frailty onset or progression.

The subdomain analyses provided further insights into which components of the KCL were associated with lower defecation frequency. Among all the participants, lower defecation frequency was associated with oral function/eating problems and depression/mood problems. These associations remained after excluding participants using antibiotics, laxatives, or bowel-regulating medications, and suggestive associations were observed for socialization/housebound and cognitive/memory problems. The KCL assesses multiple domains of frailty-related vulnerability [3, 4], and impairments in individual KCL domains have been shown to predict subsequent dependency and mortality [28]. Poor dietary and fluid intake, lower physical activity, impaired self-care, and disrupted daily routines may contribute both to lower defecation frequency and to oral, psychological, cognitive, and social vulnerability [6, 8, 23, 24]. Conversely, persistent bowel symptoms may adversely affect psychological wellbeing, daily activities, and social participation. Thus, these relationships may be bidirectional. Because the subdomain analyses were exploratory and some estimates were based on small numbers, these findings should be regarded as hypothesis-generating.

This study has several strengths. We examined multiple bowel-related indicators, including constipation status, graded categories of defecation frequency, and stool form, rather than treating bowel dysfunction as a single factor. We also assessed comprehensive frailty using the KCL and explored associations with specific KCL subdomains [3, 4]. Moreover, the models accounted for several relevant covariates, including dietary energy intake, objectively measured daily step counts, long-term care insurance certification status, and medication use related to bowel function. The sensitivity analysis further demonstrated that the association between lower defecation frequency and frailty was not limited to medication users. We conducted additional sensitivity analyses using two complementary approaches: further adjustment for selected physical, cognitive, and functional impairments and the exclusion of participants with these impairments. This allowed us to examine whether the association between a lower defecation frequency and comprehensive frailty was mainly attributable to overt functional impairment.

This study had several limitations. First, its cross-sectional design precludes causal inferences. Reduced defecation frequency may contribute to frailty through modifiable behavioral and physiological pathways; however, it may also be a consequence or marker of frailty-related decline. Second, bowel-related indicators were self-reported, which may have introduced misclassifications. Third, the operational

constipation definition was based only on defecation frequency and stool form. Other symptoms included in symptom-based diagnostic criteria, such as straining, incomplete evacuation, anorectal obstruction, and manual maneuvers, were unassessed [12]. Therefore, the constipation category used in this study should not be interpreted as equivalent to Rome IV-defined functional constipation. Fourth, the number of participants with very low defecation frequency was limited, and the composite constipation category included heterogeneous phenotypes defined by low frequency, hard stool form, or both. These factors may have reduced the statistical power and attenuated associations. Fifth, the medication-excluded analysis had a smaller sample size and may have selected participants with health characteristics different from those included in the primary analysis. Sixth, the sample size was modest for the BSFS and KCL subdomain analyses, resulting in wide confidence intervals and unstable estimates. In particular, estimates for malnutrition-related outcomes should be interpreted cautiously because of sparse data. Finally, residual confounding due to unmeasured factors, including fluid intake, other comorbidities, medication type and duration, and gastrointestinal disorders, cannot be excluded.

Conclusion

A lower defecation frequency was associated with higher odds of comprehensive frailty among community-dwelling older adults, whereas stool form and operationally defined constipation were not. This association generally remained consistent after additional adjustment for or exclusion of participants with selected physical, cognitive, and functional impairments. These findings suggest that reduced defecation frequency may be a bowel-related factor involved in potentially modifiable pathways relevant to multidimensional frailty. Longitudinal and interventional studies are needed to clarify the directionality of this association and determine whether improving bowel-related factors underlying reduced defecation frequency contributes to frailty prevention.

Abbreviations

BDHQ, Brief-type Self-administered Diet History Questionnaire

BMI, body mass index

BSFS, Bristol Stool Form Scale

CI, confidence interval

J-DEPP, Japan Dementia Early Phase Project

KCL, Kihon Checklist

MMSE, Mini-Mental State Examination

MVPA, moderate-to-vigorous physical activity

OR, odds ratio

SD, standard deviation

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethics Review Committee of the National Institute of Biomedical Innovation, Health and Nutrition (Approval No. M2024-029-06). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Clinical trial number

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are not publicly available because they contain potentially identifiable participant information. Data may be available from the corresponding author on reasonable request and subject to approval by the relevant ethics committee and institutional data-sharing policies.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

HN conceptualized the study. HN, EY, and YY contributed to the methodology. HN, MY, and RO contributed to the investigation. NM curated the data. HN drafted the manuscript. EY, YY, JK, and NM

critically reviewed and edited the manuscript. HN was responsible for project administration and funding acquisition. All authors read and approved the final manuscript.

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Authors' information

Not applicable.

References

1. Clegg, A., et al., *Frailty in elderly people.* Lancet, 2013. **381**(9868): p. 752-62.
2. Dent, E., et al., *Management of frailty: opportunities, challenges, and future directions.* Lancet, 2019. **394**(10206): p. 1376-1386.
3. Arai, H. and S. Satake, *English translation of the Kihon Checklist.* Geriatr Gerontol Int, 2015. **15**(4): p. 518-9.
4. Satake, S., et al., *Validity of the Kihon Checklist for assessing frailty status.* Geriatr Gerontol Int, 2016. **16**(6): p. 709-15.
5. Yamada, Y., et al., *Prevalence of Frailty Assessed by Fried and Kihon Checklist Indexes in a Prospective Cohort Study: Design and Demographics of the Kyoto-Kameoka Longitudinal Study.* J Am Med Dir Assoc, 2017. **18**(8): p. 733 e7-733 e15.
6. Lucak, S., T.N. Lunsford, and L.A. Harris, *Evaluation and Treatment of Constipation in the Geriatric Population.* Clin Geriatr Med, 2021. **37**(1): p. 85-102.
7. Mugie, S.M., M.A. Benninga, and C. Di Lorenzo, *Epidemiology of constipation in children and adults: a systematic review.* Best Pract Res Clin Gastroenterol, 2011. **25**(1): p. 3-18.
8. Bharucha, A.E., J.H. Pemberton, and G.R. Locke, 3rd, *American Gastroenterological Association technical review on constipation.* Gastroenterology, 2013. **144**(1): p. 218-38.
9. Esra Bozkurt, M., et al., *Investigation of the prevalence of functional constipation and its related factors for in older outpatients.* Acta Gastroenterol Belg, 2024. **87**(3): p. 361-365.
10. Lim, J., et al., *Higher frailty burden in older adults with chronic constipation.* BMC Gastroenterol, 2021. **21**(1): p. 137.
11. Liu, X., et al., *Association between frailty and chronic constipation and chronic diarrhea among American older adults: National Health and Nutrition Examination Survey.* BMC Geriatr, 2023. **23**(1): p. 745.
12. Mearin, F., et al., *Bowel Disorders.* Gastroenterology, 2016.
13. Lewis, S.J. and K.W. Heaton, *Stool form scale as a useful guide to intestinal transit time.* Scand J Gastroenterol, 1997. **32**(9): p. 920-4.

14. Vandeputte, D., et al., *Stool consistency is strongly associated with gut microbiota richness and composition, enterotypes and bacterial growth rates.* Gut, 2016. **65**(1): p. 57-62.
15. Ohno, H., et al., *Validity of an observational assessment tool for multifaceted evaluation of faecal condition.* Sci Rep, 2019. **9**(1): p. 3760.
16. Watanabe, D., et al., *Stool pattern is associated with not only the prevalence of tumorigenic bacteria isolated from fecal matter but also plasma and fecal fatty acids in healthy Japanese adults.* BMC Microbiol, 2021. **21**(1): p. 196.
17. Kobayashi, S., et al., *Both comprehensive and brief self-administered diet history questionnaires satisfactorily rank nutrient intakes in Japanese adults.* J Epidemiol, 2012. **22**(2): p. 151-9.
18. Nagayoshi, S., et al., *Validity of estimating physical activity intensity using a triaxial accelerometer in healthy adults and older adults.* BMJ Open Sport Exerc Med, 2019. **5**(1): p. e000592.
19. Tsutsui, T. and N. Muramatsu, *Care-needs certification in the long-term care insurance system of Japan.* J Am Geriatr Soc, 2005. **53**(3): p. 522-7.
20. Chen, L.K., et al., *A focus shift from sarcopenia to muscle health in the Asian Working Group for Sarcopenia 2025 Consensus Update.* Nat Aging, 2025. **5**(11): p. 2164-2175.
21. Ministry of Health, L.a.W., *Physical Activity Guide for Health Promotion 2023*. 23.
22. Sugishita M, K.Y., Sudo S, et al., *Validity and reliability of the Mini-Mental State Examination-Japanese original version. .* Japanese Journal of Cognitive Neuroscience., 2018. **20**(2).
23. Lorenzo-Lopez, L., et al., *Nutritional determinants of frailty in older adults: A systematic review.* BMC Geriatr, 2017. **17**(1): p. 108.
24. Zhao, W., et al., *Effect of physical activity on the risk of frailty: A systematic review and meta-analysis.* PLoS One, 2022. **17**(12): p. e0278226.
25. Roager, H.M., et al., *Colonic transit time is related to bacterial metabolism and mucosal turnover in the gut.* Nat Microbiol, 2016. **1**(9): p. 16093.
26. D'Amico, F., et al., *Gut microbiota in relation to frailty and clinical outcomes.* Curr Opin Clin Nutr Metab Care, 2023. **26**(3): p. 219-225.
27. Kang, S.J., et al., *Medical Management of Constipation in Elderly Patients: Systematic Review.* J Neurogastroenterol Motil, 2021. **27**(4): p. 495-512.
28. Satake, S., et al., *Predictive Ability of Seven Domains of the Kihon Checklist for Incident Dependency and Mortality.* J Frailty Aging, 2019. **8**(2): p. 85-87.

Tables

Tables 1 to 3 are available in the supplementary files section

Figures

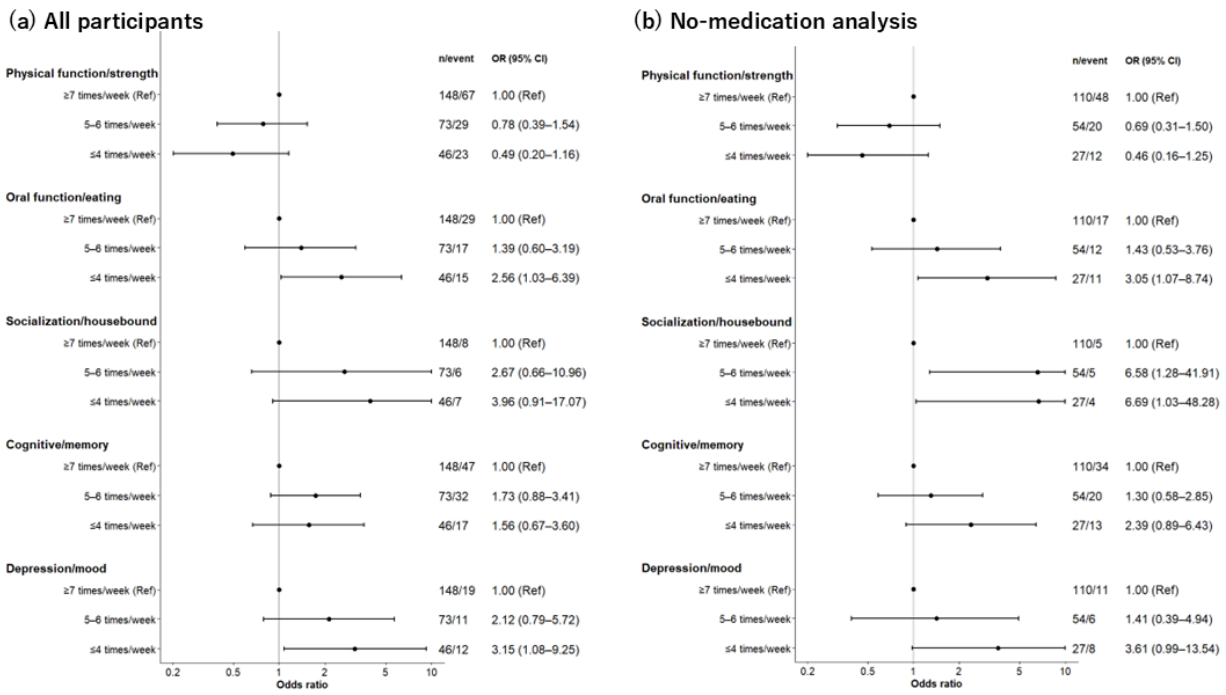


Figure 1. Associations between defecation frequency and Kihon Checklist subdomain impairments in all participants and no-medication analysis.

Figure 1

Associations between defecation frequency and Kihon Checklist subdomain impairments in all participants and no-medication analysis.

Panel (a) shows the results for all participants, and panel (b) shows the results after excluding participants who used antibiotics, laxatives, or bowel-regulating medications. Odds ratios (ORs) and 95% confidence intervals (CIs) for impairment in each Kihon Checklist (KCL) subdomain are shown according to defecation frequency, with ≥7 bowel movements/week as the reference group. Models were adjusted for sex, age, total energy intake, total dietary fiber intake, smoking status, alcohol intake, daily step counts, long-term care certification status, diabetes, cardiovascular disease, cancer, BSFS category, and use of antibiotics, laxatives, and bowel-regulating medications in panel (a). In panel (b), medication variables were omitted from the model. Arrows indicate confidence intervals extending beyond the x-axis limit.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Tables.docx