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Ⅲ.研究成果の刊行物・別刷

認知機能に着目した 介護予防プログラムの開発とその評価

田高 悦子

高齢者の認知機能は、身体的、心理的、社会的機能に深く関連し、その低下は生活機能全体の低下を招くことが知られている。他方、高齢者の認知機能の低下は、必ずしも加齢による不可逆性のものではなく、機能の不活用¹⁾や対人交流の不活発さ²⁾などが加味した、いわば、心身の生活習慣病³⁾とも指摘されている。

Laurin⁴⁾は、歩行などの軽度の身体活動と認知機能の維持との関連を明らかにし、Yoshitake⁵⁾は、有酸素運動の習慣と認知症発症リスクとの関連を明らかにしている。また Wilson は、認知機能を使用する活動⁶⁾や日頃の意図的なエピソード

記憶の回想⁷⁾がアルツハイマー病の発症リスクを低減することを示し、Verghese⁸⁾は、pleasureを伴う余暇活動や対人交流が認知機能低下の予防に資することを示唆している。すなわち高齢者の認知機能に生活のありようや生活習慣が関与していることは、もはや明白であり、焦眉の課題は、高齢者の認知機能に着目してその活性を図り、生活習慣に定着し得るような活動へ高めるための有効な介護予防プログラムの開発である。

高齢者の認知機能に着目した介護予防のためにやるべきことは2つに整理される。1つは、認知機能障害をもたない健康な高齢者を含めた一般高齢者に対するポピュレーションアプローチであり、もう1つは、軽度認知機能障害をもつ高齢者に対するハイリスクアプローチである。このような中で、筆者らが取り組んでいる研究は、図1に示すように、一般高齢者におけるポピュレーションアプローチとしての「認知症予防に向けた地域啓発キャンペーン」^{9,10)}ならびに、Mild Cognitive Impairment(以下 MCI)¹¹⁾におけるハイリスクアプローチとしての「認知症予防に向けた健康学習支援プログラム」¹²⁻¹⁶⁾の両輪的な開発と評価である。これらは、高齢者の認知機能の活性や対人交流の促進を通じた高齢者個人のQOLの維持・向上、ならびに地域づくりを意図したものである。このうち本稿では、ハイリスクアプローチプログラムを中心に述べる。

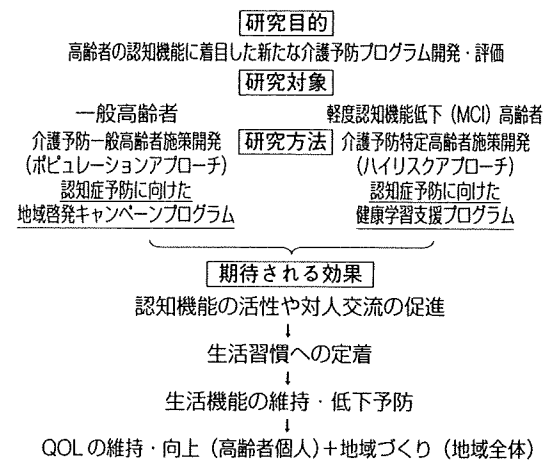


図1 長寿総合科学研究事業(認知機能に着目した介護予防プログラム)(田高班)における研究概要

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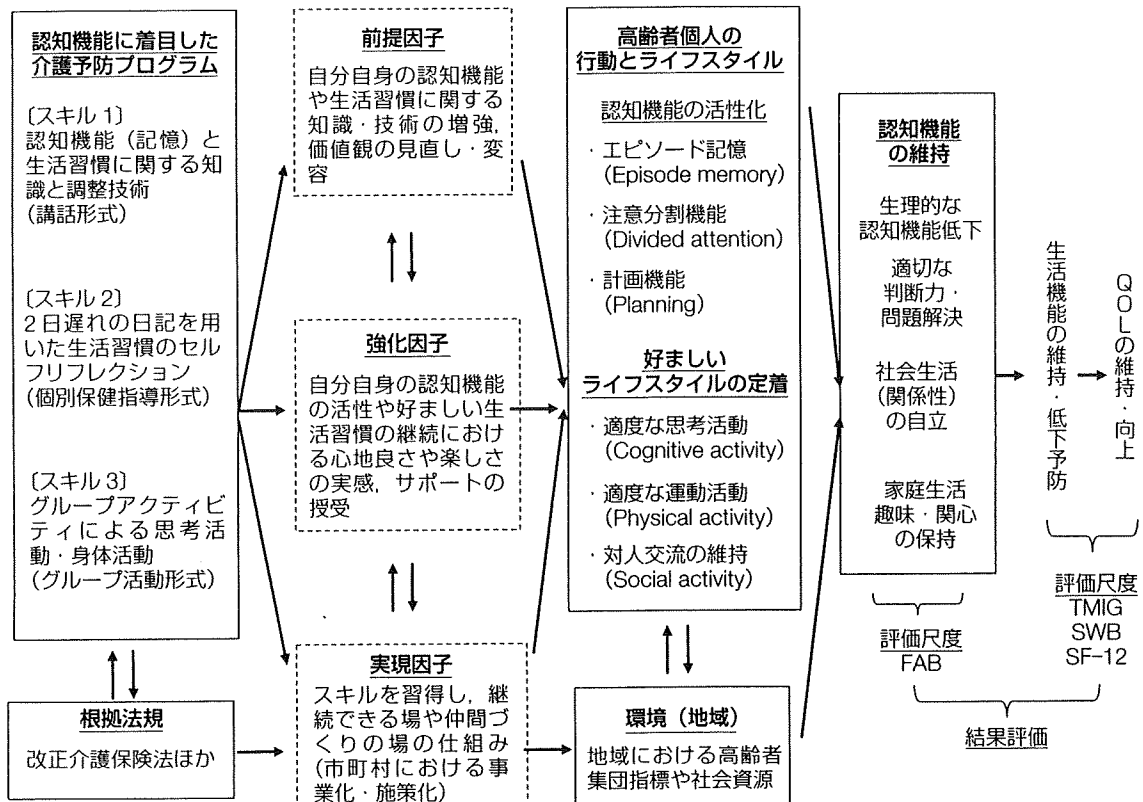


図2 認知機能に着目した介護予防プログラムの概念枠組み¹²⁾

研究方法

1. 研究地域

A県a市a地区(旧a村)は、日本海側に位置する山と海に囲まれた自然に恵まれた1次産業を主とする農漁村的地域である。a地区の人口は8,305人であり、年齢3区分別人口割合は、年少人口6.5%、生産年齢人口48.6%、老年人口44.9%であり、うち老年人口は、A県の首位を占める。a市により経年的に把握されている地域在住の認知症高齢者の伸び率は、後期高齢者の人口の急増とともに著しく増加している。すなわち認知症高齢者への対応ならびにその予防が、地域における喫緊の課題となっている。

2. 研究対象

研究対象は、a地区在住の特定高齢者候補者であって、かつ、MCIもしくはそのおそれのある

者(「基本チェックリスト」18~20の該当者、もしくはClinical Dementia Rating¹⁷⁾ 0.5の相当者であり、保健師等による介護予防事業の必要性が判断された者)である。これらを基準とした理由は、基本チェックリストの該当者のみでは、十分な事業対象者数を見込めないこと、また、保健師等による訪問活動や相談事業から把握されたハイリスク者への対応がa地区における地域保健上、本質的に重要であることによる。包含基準を満たす対象者のうち、a市保健センターより本研究事業によるプログラム開催の通知を受け、参加を希望した者25名(全数)を介入群とした。これに対し、参加を希望しなかった者のうち、介入群に年齢(±5歳)をマッチングさせて抽出された者25名を対照群とした。

3. 研究方法

研究デザインは、プリシード・プロシードモデ

ルを基に開発した介護予防プログラム(脳生き生き健康教室)(図2)¹²⁾による介入研究である。プログラムは3つのスキルから構成され3か月間にわたり展開された。スキル1は、認知機能(記憶)と生活習慣についての健康学習であり、対象者同士からなるグループワークを含めた講話形式で展開した。またスキル2は、2日遅れの日記法による生活習慣のリフレクション(内省)であり、2日前のエピソード記憶の賦活化とそれらの内容に見る生活習慣のリフレクションについて保健師等による個別保健指導形式にて展開した。さらにスキル3は、対象者と地域の支援者からなるグループによる思考活動(回想法)と身体活動(太極拳や軽体操等)を取り入れたアクティビティであり、地域のボランティアや社会資源を活用し、仲間づくりや関係づくりに向けた心地よく楽しい対人交流の機会となることを意図して展開した。

4. 評価指標

本プログラムの要素を勘案し、評価指標については、まず認知機能として Frontal Assessment Battery (FAB) (6項目; 0-18点)¹⁸⁾を用いた。また生活機能として、老研式活動能力指標(手段的自立度、知的能動性、社会的役割の3領域13項目; 0-13点)¹⁹⁾を用いた。さらにQOLとして、健康関連QOL (Short-Form 12-Item Health Survey: SF-12)²⁰⁾を用いた。解析は SAS ver. 9.1 (SAS Institute Inc., Cary, NC, USA.) を使用し、有意水準は $p < 0.05$ とした。

成績¹³⁻¹⁶⁾

研究対象者におけるベースラインの特性は、平均年齢 \pm SD では、介入群 79.8 ± 4.6 歳、対照群 81.6 ± 5.7 歳で有意な差はなく、また、他の基本属性についても有意な差は見られなかった。なお、介入群では介入前に1名が辞退し、3名が脱落した。また、対照群では2名が脱落した。よってフォローアップ調査を終了した者は、介入群21名、対照群23名となった。

介入群と対照群におけるベースラインからフォローアップまでの各評価指標の平均値の変化につ

いて見ると、まず認知機能(FAB)では、介入群では9.7点から11.2点に得点が1.5ポイント上昇したのに対し、対照群では10.1点から9.4点と0.7ポイント微減し、両群の変化の平均値に有意差を認めた($p = 0.04$)。

次いで生活機能(老研式活動能力指標)では、手段的自立度、知的能動性については、介入群と対照群でほぼ変化は見られなかったが、社会的役割については、介入群では2.4点から3.0点へと0.6ポイント得点が増加したのに対し、対照群では、2.1点から2.0点とほぼ不変であり、両群の変化の平均値に有意差を認めた($p = 0.01$)。

最後に、健康関連QOL (SF-12)では、身体的健康度関連QOLについては、両群に有意差は認められなかったが、精神的健康度関連QOLについては、介入群では45.3点から49.1点と3.8ポイント得点が増加したのに対し、対照群では43.5点から42.2点へと1.3ポイント微減し、両群の変化の平均値に有意差を認めた($p = 0.01$)。

考察

本研究は、要介護状態等となるおそれの高い65歳以上の高齢者(特定高齢者候補者)のうち、MCI、もしくはそのおそれのある者を対象とする新たな介護予防プログラム、すなわちプリシード・プロシードモデルに基づく認知機能に着目した健康学習支援型介護予防プログラムを開発し、その効果を実証的に評価したものである。研究の結果、本プログラムは、3か月間の短期評価においては、その認知機能をはじめ、生活機能の維持、拡大、ひいてはQOLの向上に一定の有効性を有することが示唆された。

本プログラムの特長の1つは、高齢者個人と環境の双方を視野に、高齢者の認知機能の活性に関連する生活習慣の内省と対人交流の促進を支援する保健指導を取り入れたところにある。この高齢者の生活習慣の内省を支援する保健指導は、対象者自らがその課題に気づき、必要な行動変容の方向性を自ら見出せるように支持するという原則においては、成人期の生活習慣病予防における保健

特集

指導と何ら変わるところはないが、そのゴールや方法においては、やや異なる。すなわちそのゴールとは、高齢者の介護予防に資する生活習慣、殊に適度の思考活動、身体活動、そして対人交流の内省と活性を通した、自立であるとともに地域づくりである。またその方法は、高齢者個々人の完成された個性や人格、あるいは価値観を捉えながら、高齢者のQOLと生きがいをより高く保つ方向性で進める健康学習支援と同時に、環境(地域)調整である。

一般に保健指導を展開する上では、当事者個人のみを対象とするアプローチでは課題の達成もしくは問題の解決にはなかなか至らないことも多い。よって、当事者個人の動機づけや信念を強化する環境や周囲からのサポートを整えることが要件となるが、高齢者であって、かつMCIの特性を有する者では、その環境や仲間づくりの意義はより大きいものとなってくる。すでに介護予防に向けた取り組みでは、地域におけるグループや一緒に行動する仲間と展開することの意義が指摘²¹⁾されて久しい。本プログラムにおいても、高齢者の日々の思考、運動、対人交流の振り返りを助力し、今後の動機付けを支援しつつ、意図したことは共通の関心や課題を持つ同世代の仲間づくりや関係づくりであり、地域における支援者の育成と地域づくりである。すなわち介護予防では個と集団、また地域全体を視野に入れた展開が不可欠である。

最後に、今後の介護予防の課題について述べる。まず1点目は、認知機能に着目した予防ニーズの高い対象者(MCI)を地域で効果的・効率的に把握するための有効な方法の検討である。その際MCIは普段の日常生活や社会生活と密接に関連した状態であることから²²⁾、各区市町村が地域の実情に応じて、日頃の保健活動等からの情報を活かして対象者を把握・決定できるような仕組みも加味される必要がある。2点目は、事業不参加の対象者に対する支援の検討である。MCIは家族や知人による物忘れの指摘はあるが、高齢者本人の自覚はある場合とない場合がある。また認知機

能の低下の範囲は部分的であって、全般的ではない。すなわち一見、問題のない普通の高齢者である。これらの者における事業参加への動機付けや支援はそう容易なことではない。しかしながらこのことについて検討しない限り、介護予防の対象は事業参加に手を挙げた者のみとなり、地域全体には到底及ばないことになる。3点目は、事業終了後の参加者の活動の自主化のための支援の検討である。MCIの特性を勘案すれば、プログラム終了後も好ましい生活習慣や対人交流を日常に定着させるためには、環境(場)や保健師等専門職の一定のフォローが必要である。最後に4点目は、事業による地域全体の健康レベルにおける成果の検討である。事業の対象となった高齢者(関連して「特定高齢者」の呼称についても検討の余地がある)への評価のみでなく、当該事業が地域全体にどのような成果をもたらしたのかについて評価できる方法の開発が必要と考える。

高齢者の介護予防では、単に高齢者の個々のリスクファクターの改善のみならず、高齢者一人ひとりのQOLのできる限りの維持・向上を目指すことが重要である。加えて、高齢者一人ひとりが自立した、生きがいのある生活を送れるような基盤を地域でつくっていくことが重要と言えるであろう。

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臨床医が日常遭遇する治療法を、全診療科1,094項目にわたって網羅。各項目の執筆は第一線の専門医による。日本の保険診療に沿った現時点での最新・最高の治療法を解説した治療年鑑。薬物療法については随所に処方例として詳述(商品名を記載)。

ORIGINAL ARTICLE: EPIDEMIOLOGY, CLINICAL
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Comprehensive assessment of nutritional status and associated factors in the healthy, community-dwelling elderly

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Background: Malnutrition among the elderly has become a serious problem as their population increases in Japan. To approach the risk of malnutrition in the healthy, community-dwelling elderly is important for early prevention of malnutrition. The nutritional status and mutable associated factors with poor nutritional status specific to the healthy elderly were examined comprehensively.

Methods: One hundred and thirty healthy elderly people from a senior college in Tokyo, Japan were eligible for this study. Nutritional status was evaluated by Mini-Nutritional Assessment (MNA). The demographic status and potential correlates with poor nutritional status, including the physical factors (mobility, cognitive impairment and oral status) and the psychosocial factors (depression, self-efficacy, attitudes toward health, instrumental activities of daily living, public health service knowledge, and difficulty and dissatisfaction with meal preparation) were investigated. The multiple linear regression analysis using a stepwise procedure adjusted for demographic status was performed to detect independent associated factors.

Results: There were 16 participants (12.6%) at risk of malnutrition. The independent associated factors with lower MNA scores were depression ($\beta = -0.27$, $P = 0.005$), lower self-efficacy ($\beta = 0.25$, $P = 0.009$), lower attitudes toward health scores ($\beta = 0.21$, $P = 0.02$) and difficulty with meal preparation ($\beta = -0.18$, $P = 0.03$).

Conclusion: The prevalence of the healthy elderly at the initial risk of malnutrition was relatively high and should not be overlooked. The comprehensive geriatric screening and intervention including mental health, health management and life-situation will be important for the healthy, community-dwelling elderly.

Keywords: comprehensive health care, healthy elderly people, malnutrition, nutritional assessment, preventive health services.

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Introduction

Recently, malnutrition among the elderly has become a serious problem as their population increases in Japan. Malnutrition is defined as "the state of deficient energy or protein intake or absorption, which is characterized by weight loss and changes in body composition".¹ More than 50% of the elderly in hospitals and institutions were malnourished.²⁻⁴ Malnutrition leads to poor outcomes such as functional decline, frailty, the decline of quality of life and higher mortality.⁵⁻⁷ Moreover, it is possible that severe malnutrition has become too advanced to be improved.⁸ Therefore, early screening and preventive intervention are one of the most important aspects for successful aging.

Although recognition of the need for the prevention of malnutrition is widespread, many studies on malnutrition have been conducted for the frail elderly or hospitalized people, not for the healthier elderly. Because 80% and more of the elderly in Japan are the healthy elderly who do not need care, they are considered to be the most prior targets of early nutritional screening. A previous study, using a common screening tool (i.e. serum albumin), has reported that less than 1% of the healthy, community-dwelling elderly were at moderate risk of malnutrition,⁹ which is, however, considered the almost same meaning as obvious malnutrition, in need of treatment rather than prevention. Because one of the signs of malnutrition (e.g. the declines in muscle strength) can occur even within the normal range of serum albumin levels,¹⁰ the prevalence of the potential risk population in the healthy elderly must be investigated for prevention as this number has been increasing, especially in Japan.

Although there are many factors associated with malnutrition, including demographic, physical and psychosocial factors such as age, living alone, eating and oral problems, low functional capacity, depression and more,^{11,12} they are factors almost applied to the frail elderly not to the healthy elderly. Factors related to each population are different in terms of the possibility of intervention or priority due to the physical and psychosocial differences between the healthy elderly and the frail. Therefore, for effective intervention in the healthy elderly, factors must be applied to the specific population, that is the healthy elderly in this study, and be mutable to promote behavioral change for prevention.

The aims of this study were: (i) to describe the nutritional status comprehensively in the healthy, community-dwelling elderly; and (ii) to investigate mutable associated factors with poor nutritional status specific to this population as a base for future preventive intervention in Japan.

Methods

Study population and settings

The study enrolled 210 eligible participants aged 65 and older who met the criteria for inclusion at Setagaya Senior College, which is a public recurrent school for the healthy elderly in Tokyo, Japan. The criteria for inclusion were that the individual was: (i) community-dwelling; and (ii) not certified as "on the care level" according to the Japan Long-term Care Insurance System.

This cross-sectional study conducted a questionnaire survey and subsequent clinical evaluations performed by well-trained observers at the Setagaya Senior College in November–December 2006. One hundred and thirty-one participants underwent both survey and evaluations. Moreover, one participant who did not meet inclusion criteria was excluded from the analytical sample. Thus, a total of 130 participants (61.9%) were analyzed. Ethical approval was obtained from the Institutional Review Board of University of Tokyo and the Setagaya Senior College Administrative Office, and written informed consent was obtained from each participant.

Nutritional status

The Mini-Nutritional Assessment (MNA) was used to evaluate the risk of malnutrition. The MNA was developed in Europe to evaluate the nutritional status of the elderly¹³ and translated into Japanese,¹⁴ including 18 items (range of scores, 0–30) consisting of four domains: (i) anthropometric; (ii) general; (iii) dietary; and (iv) subjective assessment. Participants were categorized by the MNA into three groups: (i) well-nourished (≥ 24 points); (ii) at risk of malnutrition (17–23.5 points); and (iii) malnutrition (< 17 points). The validity of the MNA for malnutrition has been proven for the Japanese elderly; the sensitivity and specificity for hypoalbuminemia was 0.81 and 0.86, respectively.¹⁴ The MNA also has been shown to have good reliability according to internal consistency (Cronbach's alpha, 0.8) and test-retest reliability (intraclass correlation coefficient, 0.89).¹⁵ Anthropometric assessment of the MNA was conducted according to the MNA clinical practice user guide.

Demographic characteristics

Age, sex, living arrangement, economic status and comorbidity were assessed for demographic characteristics which were used as covariates in the analyses. For living arrangement, the participants were classified as living alone or not. Economic status was categorized subjectively as "good", "average" or "bad". Comorbidity was measured by the Charlson index¹⁶ in the form of a self-report questionnaire, which is a 17-item scale

(range of scores, 0–30) with higher scores indicating higher or more severe comorbidity. This score has been shown to correlate with mortality in Japan¹⁷ and have excellent interrater reliability (intraclass correlation coefficients, 0.80).¹⁸

Physical factors

Physical functional status was measured by “1 km mobility”,¹⁹ which consists of the following self-report categories: “I am able to walk without difficulty”, “I am able to walk with difficulty” and “I am unable to walk”.

Cognitive impairment was measured by the Frontal Assessment Battery (FAB).²⁰ The FAB is a six-item performance test (range of scores, 0–18). The FAB has been used to detect mild cognitive impairment (MCI) with good validity (concurrent and discriminant validity), and reliability (interrater reliability and internal consistency).²¹

For dental status, the use of partial or complete dentures was assessed. Subjective dental and oral problems were also assessed, including bad condition of teeth, problems swallowing, problems chewing and dry mouth. Oral problems were defined as problems with frequency of greater than “sometimes”. The total number of problems was calculated and classified into: 0, 1 or ≥ 2 problems.

Psychosocial factors

Mental status was measured by the Geriatric Depression Scale-5 (GDS-5),²² a dichotomized five-item scale (range of scores, 0–5) for screening depression. Depression was defined as a score of two or higher. The GDS-5 has been shown to have good validity for clinical diagnosis (sensitivity of 0.94 and specificity of 0.81), and interrater reliability ($\kappa = 0.88$).²³ A Japanese version of GDS-5 was used.

Self-efficacy was evaluated by the Perceived Health Competence Scale (PHCS).²⁴ The PHCS is a domain-specific self-efficacy scale including eight items (range of scores, 0–40) used to measure the degree of ability to manage health outcomes. A Japanese version of the PHCS was used, which has been shown to have good construct, content validity and internal consistency.²⁵

To investigate actual health attitudes, the following dichotomized four-item questions (range of scores, 0–4) were used: “Do you know your ideal body weight?”, “Do you know your energy requirements?”, “Do you usually weigh yourself?” and “Do you take an interest in the size of your meals?”. The total score was calculated as the score of “attitudes toward health”, with higher scores indicating better attitudes.

Instrumental activities of daily living (IADL) were measured by the Tokyo Metropolitan Institution of Gerontology Index of Competence (TMIG index),

which was developed in Japan.²⁶ The TMIG index includes 13 dichotomized items (range of scores, 0–13) consisting of three subcategories: instrumental self-maintenance (range of scores, 0–5), intellectual activity (0–4) and social role (0–4). The TMIG index has been shown to have good validity (construct, discriminant and predictive validity) and reliability (internal consistency and test–retest reliability).²⁷

To investigate the degree of knowledge regarding public health services, the following public health services were selected: meals-on-wheels, health checkups, dietary counseling, and a service for the prevention of malnutrition. The total number of knowing services was calculated (range of scores, 0–4). Higher scores indicated better knowledge about services.

Meal preparation, including cooking and shopping, was measured by the following two measures: (i) the degree of difficulty felt due to physical or mental reasons; and (ii) the degree of dissatisfaction felt with respect to one’s own meal preparation. The degree of difficulty was measured by a four-level Likert scale (“often”, “sometimes”, “seldom” and “never”) and difficulty was defined as “a subjective feeling of difficulty toward either cooking or shopping often or sometimes”. For the degree of dissatisfaction, dissatisfaction was defined as “a subjective feeling of dissatisfaction with either cooking or shopping”.

Statistical analysis

Descriptive statistics were shown by the mean \pm standard deviation (SD) for continuous variables and the number (percentage) for categorical variables. In the first analyses for the detection of possible associated factors to poor nutritional status, relationships between each factor and the MNA total score were examined by calculating Spearman’s r . The factors that correlated with the MNA at $P < 0.20$ were included in the multivariate analyses. In the second analyses to examine the independent effects of possible associated factors on poor nutritional status, a multiple linear regression analysis using a stepwise procedure was performed. The significance levels for both entry and stay were set at $P < 0.15$. The final multivariate model included demographic characteristics (age, sex, living arrangement, economic status and comorbidity) as covariates. The statistical significance level was set at $P = 0.05$. Analyses were conducted by Statistical Analysis System version 9.1 (SAS Institute, Cary, NC, USA).

Results

Characteristics of participants

The characteristics of the participants are shown in Tables 1 and 2. The mean age \pm SD was 72.2 ± 4.3 years old. Sixty-two (47.7%) participants were males. The

Table 1 Demographic characteristics of participants ($n = 130$)

Characteristics	Values
Age (years, mean \pm SD)	72.2 \pm 4.3
Males, n (%)	62 (47.7)
Living arrangement, n (%)	
Living alone	27 (20.8)
Living together	103 (79.2)
Economic status, n (%)	
Good	92 (70.8)
Average	31 (23.9)
Bad	7 (5.3)
Charlson index, n (%)	
0	102 (78.5)
1	19 (14.6)
≥ 2	9 (6.9)

SD, standard deviation.

Charlson index detected that 102 (78.5%) participants had no comorbidity. Only two were certified as on the support level.

Nutritional status

The nutritional characteristics of the participants are shown in Table 3. For nutritional status, the mean MNA score \pm SD was 27.0 \pm 2.2. One hundred and eleven participants (87.4%) were well-nourished, 16 participants (12.6%) were at risk of malnutrition and none were malnourished (score was missing for three participants).

Correlations between nutritional status and associated factors

The results of the first and second analyses are shown in Table 4. In the first analyses, possible factors associated with lower MNA scores were explored using correlation coefficients. The following variables correlated at $P < 0.20$ with the MNA score and were included in the multivariate model: three subcategories of the TMIG score, dental status, depression, the PHCS score, the attitudes toward health score, the public health service knowledge score, and difficulty and dissatisfaction with meal preparation. In addition, demographic characteristics (sex, age, living arrangement, economic status and the Charlson score) were included as covariates in the multiple regression model.

In the second analyses, performed to detect the independent effects of possible factors associated with lower MNA scores, meaning poorer nutritional status, a multiple regression analysis adjusted for demographic characteristics was conducted using a stepwise

Table 2 Physical and psychosocial characteristics of participants ($n = 130$)

Characteristics	Values
1 km mobility, n (%)	
Can walk without difficulty	121 (95.3)
Can walk with difficulty or cannot	6 (4.7)
Frontal Assessment Battery, mean \pm SD	15.5 \pm 1.8
Dental status, n (%)	
Natural dentition	67 (51.5)
Partial or complete dentures	63 (48.5)
Number of dental and oral problems, n (%)	
0	57 (44.9)
1	33 (26.0)
≥ 2	37 (29.1)
Geriatric Depression Scale-5	
≥ 2 (risk of depression), n (%)	15 (11.5)
Perceived Health Competence Scale, mean \pm SD	27.4 \pm 6.5
Attitudes toward health, mean \pm SD	3.2 \pm 0.9
TMIG index total score, mean \pm SD	12.3 \pm 1.0
Instrumental self-maintenance score, mean \pm SD	4.9 \pm 0.3
Intellectual activity score, mean \pm SD	3.9 \pm 0.3
Social role score, mean \pm SD	3.5 \pm 0.9
Public health service knowledge, n (%)	
0	6 (5.0)
1	45 (37.2)
≥ 2	70 (57.9)
Difficulty with meal preparation, n (%)	14 (10.8)
Dissatisfaction with meal preparation, n (%)	13 (10.6)

TMIG, Tokyo Metropolitan Institute of Gerontology Index of Competence.

approach. The independent associated factors with lower MNA scores were depression (standardized $\beta = -0.27$, $P = 0.005$), lower PHCS scores ($\beta = 0.25$, $P = 0.009$), lower attitudes scores ($\beta = 0.21$, $P = 0.02$) and difficulty with meal preparation ($\beta = -0.18$, $P = 0.03$). Dental status did not significantly correlate with the MNA score ($\beta = -0.15$, $P = 0.09$). All demographic characteristics did not significantly correlate with the MNA score. The adjusted R^2 of the final model was 0.38.

Discussion

The results of this study suggest that approximately 13% of the healthy elderly are at risk of malnutrition using a comprehensive and valid instrument, the MNA, and that poor nutritional status has a significant association with depression, lower self-efficacy, a lower

Table 3 Nutritional characteristics of participants. (*n* = 130)

MNA items (rating)	Score, <i>n</i> (%)				
	0	0.5	1	2	3
1 Body mass index (0, <19; 1, 19 to <21; 2, 21 to <23; 3, ≥23)	4 (3.1)	–	26 (20.3)	36 (28.1)	62 (48.5)
2 Mid-arm circumference in cm (0, <21; 0.5, 21 to ≤22; 1, >22)	2 (1.6)	4 (3.1)	122 (95.3)	–	–
3 Calf circumference in cm (0, <31; 1, ≥31)	6 (4.7)	–	123 (95.3)	–	–
4 Weight loss during last 3 months (0, >3 kg; 1, does not know; 2, 1–3 kg; 3, no weight loss)	1 (0.8)	–	1 (0.8)	26 (20.0)	102 (78.4)
5 Lives independently (not in a nursing home or hospital) (0, no; 1, yes)	0 (0)	–	130 (100)	–	–
6 Takes more than three prescription drugs per day (0, yes; 1, no)	28 (21.7)	–	101 (78.3)	–	–
7 Has suffered psychological stress or acute disease in the past 3 months (0, yes; 2, no)	13 (10.0)	–	117 (90.0)	–	–
8 Mobility (0, bed- or chair-bound; 1, able to get out of bed/chair but does not go out; 2, goes out)	0 (0)	–	0 (0)	130 (100)	–
9 Neuropsychological problems (0, severe dementia or depression; 1, mild dementia; 2, no psychological problems)	0 (0)	–	1 (0.8)	129 (99.2)	–
10 Pressure sores or skin ulcers (0, yes; 1, no)	0 (0)	–	130 (100)	–	–
11 How many full meals does the patient eat daily? (0, one meal; 1, two meals; 2, three meals)	0 (0)	–	5 (3.9)	124 (96.1)	–
12 Selected consumption markers for protein intake					
• At least one serving of dairy products per day?					
• Two or more servings of legumes or eggs per week?					
• Meat, fish or poultry every day?					
(0, if 0 or 1 yes for the above questions; 0.5, if 2 yes; 1, if 3 yes)	6 (4.6)	24 (18.5)	100 (76.9)	–	–
13 Consumes two or more servings of fruits or vegetables per day? (0, no; 1, yes)	5 (3.9)	–	125 (96.1)	–	–
14 Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties? (0, severe loss; 1, moderate loss; 2, no loss)	1 (0.8)	–	7 (5.6)	117 (93.6)	–
15 How much fluid is consumed per day? (0, less than 3 cups; 0.5, 3–5 cups; 1, more than 5 cups)	10 (7.8)	52 (40.6)	66 (51.6)	–	–
16 Mode of feeding (0, unable to eat without assistance; 1, self-fed with some difficulty; 2, self-fed without any problem)	1 (0.8)	–	1 (0.8)	128 (98.4)	–
17 Do they view themselves as having nutritional problems? (0, major malnutrition; 1, does not know or moderate malnutrition; 2, no nutritional problem)	9 (7.0)	–	20 (15.5)	100 (77.5)	–
18 In comparison with other people of the same age, how do they consider their health status? (0, not as good; 0.5, does not know; 1, as good; 2, better)	15 (11.5)	6 (4.6)	54 (41.6)	55 (42.3)	–

Data were missing for item 3, 6, 11, 15 and 17 (*n* = 1, respectively), 1 and 2 (*n* = 2, respectively), and 14 (*n* = 5). MNA, Mini-Nutritional Assessment.

Table 4 Correlation between the nutritional status and factors, and the final multiple regression model

Variables	Correlation coefficient [†]	P-value	Multiple regression model [‡]	
			Standardized β	P-value
Age	0.05	0.58	0.02	0.82
Sex	0.11	0.25	0.11	0.20
Living arrangement	-0.02	0.85	0.07	0.46
Economic status	-0.17	0.06	0.07	0.41
Charlson index	-0.27	0.003	-0.13	0.14
1 km mobility	0.11	0.22	Not included [§]	
Frontal Assessment Battery	0.11	0.23	Not included	
Dental status	-0.23	0.009	-0.15	0.09
Number of dental and oral problems	-0.11	0.21	Not included	
Depression (GDS, ≥ 2)	-0.37	<0.001	-0.27	0.005
Perceived Health Competence Scale	0.48	<0.001	0.25	0.009
Attitudes toward health	0.23	0.01	0.21	0.02
TMIG index total score	0.30	0.001	Not selected [§]	
Instrumental self-maintenance	0.14	0.12	Not selected	
Intellectual activity	0.22	0.02	Not selected	
Social role	0.25	0.007	Not selected	
Public health service knowledge	0.16	0.09	Not selected	
Difficulty with meal preparation	-0.23	0.01	-0.18	0.03
Dissatisfaction with meal preparation	-0.16	0.08	Not selected	

[†]Spearman's *r*. [‡]The final multiple regression model using stepwise procedure was adjusted for demographic characteristics (age, sex, economic status, living arrangement and the Charlson index). Adjusted $R^2 = 0.38$. [§]"Not included" means "not included in the independent variables for the multivariate model". "Not selected" means "not selected in the final model". GDS, Geriatric Depression Scale.

score of attitudes toward health and difficulty with meal preparation.

The prevalence of risk of malnutrition in this study was high, compared with a previous study in Japan conducted in a community, which, using serum albumin, reported that less than 1% were at moderate risk of malnutrition.⁹ Another study conducted in Ireland also reported that only 3% of the healthy elderly had malnutrition, defined as having a body mass index of less than 20.²⁸ On the other hand, the results in this study were almost consistent with other research using MNA, which reported the prevalence of the elderly at risk of malnutrition as 17%.²⁹ These may suggest that comprehensive nutritional assessments, like MNA, will be more useful to detect the potential risk population in the healthy elderly before a moderate decline of nutritional status is reflected in low serum albumin.^{13,14} Although it might be possible that normal physiological change influences the nutritional status of the elderly in the risk population, it is clear that the risk group of MNA had poorer outcomes such as mortality or hospital admission than the well-nourished group had.⁵ If 13% of the healthy elderly are at risk of malnutrition detected by MNA, more than 2 million of the Japanese elderly will be at risk of malnutrition. This indicates that there can be relatively many elderly people with a mild or initial risk of malnutrition in Japan. Therefore, in

order to prevent declines in nutritional status and functional capacity, early comprehensive screening and early intervention in initial risk populations will be important before irrecoverable change occurs in nutritional status.⁸ Further research will be needed to investigate the nutritional change of healthy, community-dwelling elderly people at risk of malnutrition.

There were four factors associated with poor nutritional status. This result revealed the importance of comprehensive geriatric assessment including mental health and life-situation for prevention of malnutrition.

Depression had already been identified as an associated factor in the frail or hospitalized elderly³ because depression reduces dietary intake.³⁰ Even in the healthy elderly, depression was found to be one of the associated factors, which means comprehensive assessment and intervention will be effective in preventing malnutrition in the healthy elderly.

Lower self-efficacy, a lower score of attitudes toward health and difficulty with meal preparation are associated factors unique to the healthy elderly. Self-efficacy has been recognized to be associated not only with eating behaviors, including dietary variety,²⁵ but also with self-perceived health.³¹ This may influence one's health management directly through behavior and indirectly through self-perceived health. Moreover, attitudes toward health evaluated in this study reflect actual

health behaviors and interest as well as health knowledge. Therefore, low self-efficacy can change one's habit, especially dietary habit, into a worse one, and low attitudes will become a barrier for the elderly in coping with inappropriate changes, causing the risk of malnutrition. These results indicated that factors related to health management or behavior are the direct target for the healthy elderly to prevent malnutrition. Further research will be needed to detect more detailed and practical contents of attitudes toward health.

Difficulty with meal preparation was also associated with poor nutritional status. "Tiredness", which is a general perception in daily living, is known as a predictor of the decline in functional capacity among the community-dwelling elderly.³² In comparison, "Difficulty with meal preparation", which is the specific perception to the dietary behavior, can be a predictor of the decline in nutritional status. Moreover, IADL, which had been associated with nutritional status in the frail elderly,⁶ were not associated with nutritional status in this study. "Difficulty with meal preparation" can be the key factor of malnutrition, especially in the healthy elderly, rather than abilities such as IADL. Therefore, the assessment of not only abilities but also actual life-situation or perception of meal preparation are important to prevent malnutrition among the healthy, community-dwelling elderly.

There were several limitations in this study. First, because sample size was not large enough and the participants were recruited from only one city, the results in this study may not be necessarily generalized. Causal relationships between the factors and nutritional status were unclear due to the use of a cross-sectional design. Because this study focused on revealing the nutritional characteristics of the healthy elderly, the majority of factors were skewed due to the ceiling effect, and this might explain the lack of correlation between some factors and the MNA. Finally, there may have been unrecognized factors and stratified relationships among various factors at different levels. Further research is needed to develop validated intervention models for more effective prevention.

In conclusion, this study revealed that people at risk of malnutrition were relatively common, even in the healthy, community-dwelling elderly. Detecting and following up these people will be needed to prevent the decline of nutritional status in the future. The comprehensive geriatric screening and intervention including mental health, health management and life-situation will be important for the healthy, community-dwelling elderly.

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