Association of hearing loss with behavioral and psychological symptoms in patients with dementia

Dear Editor,

Behavioral and psychological symptoms of dementia (BPSD) are associated with a number of adverse outcomes including decreased quality of life in patients and their caregivers, earlier institutionalization, and increased healthcare costs. Ishii *et al.* developed a conceptual framework to comprehensively capture factors associated with the development of rejection of care behavior, one type of BPSD.[1] The framework suggested that sensory impairment, such as hearing loss, could be a contributing factor of BPSD. Previous studies identified a positive association of hearing loss with cognitive dysfunction[2] and depressive symptoms.[3] However, the relationship between hearing loss, visual impairment and BPSD is unclear. We hypothesized that hearing loss might have an adverse influence on BPSD.

To test this hypothesis, a cross-sectional analysis was carried out between hearing loss and BPSD, using the medical records of our geriatric department. The data were drawn from the medical records of 99 consecutive patients (41 men, 58 women) who were admitted to the Department of Geriatric Medicine, The University of Tokyo Hospital, Tokyo, Japan, from October 2006 to October 2008 for evaluation of cognitive impairment. The present study was approved by the ethics committee of the Graduate School of Medicine, The University of Tokyo.

A total of 45 patients were diagnosed as Alzheimer's disease, 22 as mild cognitive impairment, six as diffuse Lewy body disease, six as mixed-type Alzheimer's disease and vascular dementia, four as vascular dementia, three as fronto-temporal dementia and 13 as other types of dementia, such as hydrocephalus or corticobasal degeneration, according to the diagnostic criteria of each disease.

The severity of hearing loss was ascertained based on the findings of doctors' examinations, and by asking patients and their family members about the impact of hearing loss on daily life (e.g. difficulty in normal conversation, social interaction or listening to TV).[4,5]

Assessment of BPSD was carried out using screening questions for neuropsychiatric symptoms, such as delusions, hallucinations, agitation, depression, anxiety, elation, apathy, disinhibition, irritability, motor disturbance, wandering, night-time behavior and refusal, that cause caregivers severe stress. A positive answer to a screening question was regarded as indicative of the presence of BPSD.

BPSD were present in 43 patients (43%). The observed symptoms were as follows: depression in eight, delusions in eight, aggression in six, hallucinations in five, agitation in five, wandering in four, night-time behavior in two, refusal in two and others in three patients.

BPSD were more frequently observed in patients with hearing loss than in those without (Table 1). Patients with hearing loss were older, although there was no significant difference in cognitive function measured by the Mini-Mental State Examination (MMSE) total score and depression score between patients with and without hearing loss (Table 1). The prevalence of some symptoms was significantly different between patients with and without hearing loss, but did not add important information because of the small number of each symptom.

Multiple logistic regressions with adjustment for age, sex, total MMSE score and self-reported visual impairment showed that hearing loss was independently associated with the presence of BPSD (odds ratio 4.65, 95% confidence interval 1.70–12.00).

Hearing loss is widespread in older patients, and is often unrecognized or even dismissed in clinical practice. However, the association between hearing loss and BPSD observed in the present study suggests the need to recognize and treat hearing loss when BPSD are observed. The effective treatment and management of hearing loss might help alleviate or resolve some BPSD symptoms. Further study is warranted to confirm the association between BPSD and hearing loss using a large number of participants, and to examine the effect

Table 1 Association between behavioral and psychological symptoms of dementia and hearing loss

	Hearing loss (−)	Hearing loss (+)	*P*
n	68	31	
Women	56%	65%	<0.01
Age (years)	77 ± 6	81 ± 5	<0.01
MMSE	22.0 ± 4.9	21.2 ± 4.8	0.45
GDS-15	5.6 ± 3.4	7.1 ± 4.4	0.22
BPSD	32%	68%	<0.01
Visual impairment	45%	70%	<0.01

Values are expressed as mean ± SD. BPSD, behavioral and psychological symptoms of dementia; GDS-15, Geriatric Depression Scale-15; MMSE, Mini-Mental State Examination.

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of interventions on hearing loss on BPSD. Although it has been reported that visual impairment is associated with cognitive dysfunction,[2] no significant relationship was found between self-reported visual impairment and BPSD in the present participants (data not shown).

In conclusion, the present preliminary study showed that hearing loss was associated with BPSD in patients with mild to moderate dementia.

Disclosure statement

The authors declare no conflict of interest.

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COMMENTS

Associated factors with gender gap in life expectancy: Recommendation for the use of healthy life expectancy

Dear Editor,

Liu *et al.* reported a negative association between gender gaps in life expectancy (GGLE) and happiness, human development index (HDI) and Gender Empowerment Measure (GEM) in Organization for Economic Cooperation and Development (OECD) countries.[1] In addition, Liu *et al.* reported a positive association between GGLE and age-adjusted all-cause gender mortality ratio, but HDI had no significant association with GGLE in Japan.[2] The authors explained the recent decline of GGLE by the resemblance of lifestyles between gender, and HDI was not a significant contributor to GGLE in Japan. I have some concerns about their study outcome.

First, their study on OECD countries is a repeated cross-sectional ecological study, and their conclusion cannot simply be applied for the same relationship in Japan. There were many factors to be considered for the association, such as ethnic difference of lifestyles. The cause of GGLE should also be evaluated by using both demographic and health-related information.[3,4]

Second, gender differences in happiness, HDI and GEM cannot be considered in their analyses, and causality on the association between GGLE and happiness or HDI is difficult to be determined.

Third, life expectancy is an indicator of biological degree of longevity in life, and healthy life expectancy (HLE) is another indicator to understand the association between GGLE and happiness or HDI. HLE is defined as the "average number of years that a person can expect to live in 'full health' ". HLE calculation by Jagger *et al.*[5] is widely accepted in studies on health inequalities in European Union countries,[6] and HLE have been reported in almost all the countries.[7,8] HLE is affected by mortality and disability,[9] and HLE reflects successful aging. HLE in women is longer than men in many countries,[10] and GGLE by using HLE seems informative to understand the association with HDI.

Disclosure statement

The authors declare no conflict of interest.

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RESEARCH ARTICLE Open Access

Staging of mobility, transfer and walking functions of elderly persons based on the codes of the International Classification of Functioning, Disability and Health

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Abstract

Background: The International Classification of Functioning, Disability and Health (ICF) was introduced by the World Health Organization as a common taxonomy to describe the burden of health conditions. This study focuses on the development of a scale for staging basic mobility and walking functions based on the ICF.

Methods: Thirty-three ICF codes were selected to test their fit to the Rasch model and their location. Of these ICF items, four were used to develop a Guttman- type scale of "basic mobility" and another four to develop a"walking" scale to stage functional performance in the elderly. The content validity and differential item functioning of the scales were assessed. The participants, chosen at random, were Japanese over 65 years old using the services of public long-term care insurance, and whose functional assessments were used for scale development and scale validation.

Results: There were 1164 elderly persons who were eligible for scale development. To stage the functional performance of elderly persons, two Guttman-type scales of "basic mobility" and "walking" were constructed. The order of item difficulty was validated using 3260 elderly persons. There is no differential item functioning about study location, sex and age-group in the newly developed scales. These results suggested the newly developed scales have content validity.

Conclusions: These scales divided functional performance into five stages according to four ICF codes, making the measurements simple and less time-consuming and enable clear descriptions of elderly functioning level. This was achieved by hierarchically rearranging the ICF items and constructing Guttman-type scales according to item difficulty using the Rasch model. In addition, each functional level might require similar resources and therefore enable standardization of care and rehabilitation. Illustrations facilitate the sharing of patient images among health care providers. By using the ICF as a common taxonomy, these scales could be used internationally as assessment scales in geriatric care settings. However these scales require further validity and reliability studies for international application.

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Background

In 2001, the World Health Organization (WHO) approved the International Classification of Functioning, Disability and Health (ICF) to describe functioning in health and health-related contexts. The challenges of implementing the ICF [1] in various fields such as medicine, rehabilitation, long-term care, or social care include the operationalization and quantification of the ICF categories [2]. Unlike the International Classification of Diseases (ICD) [3], also developed by the WHO, to which medical records can serve as an information resource, the ICF measures the problems in an individual's functioning with respect to a health condition. The ICF provides alphanumeric codes that are arranged in a hierarchy for each ICF category or functioning domain. The number of digits in an ICF code represents an increasing level of precision in the categorization or definition for each function in that domain. However, the high number of codes (n = 1434) makes the use of the ICF by health care professionals particularly challenging. Therefore, to facilitate the use of the ICF codes, it is necessary to tailor them to the target population.

As the ICF was developed as a classification system, it requires an additional step for use as a measurement system, i.e., using a qualifier with the ICF code. A user must select an ICF code, followed by measurement using an ICF qualifier. Qualifiers are numeric codes that specify the extent or the magnitude of the disability in that category. The original ICF qualifier is used to record the severity of the problem: no problem; mild; moderate; severe; or complete problem (included in the codes are qualifier 8 (not specified) and qualifier 9 (not applicable)). However, this approach prohibited us from using the ICF for two reasons. First, it was difficult to select relevant ICF codes from the approximately 1434 ICF codes, and if we selected ICF codes for each person, we could not compare the specific function to other persons, because the ICF codes selected for various individuals may not be the same. Second, the reliability of a qualifier for quantification of severity of a disability was not always satisfactory [4,5].

Therefore, for adaptation of the ICF codes, *a priori* selection of ICF codes specific to a target population can minimize the burden of selecting numerous ICF codes. In addition, the use of a simpler qualification tool makes the ICF easier to use as a basis for measurement

There have been several studies aimed at tailoring the number of ICF codes [4,6-9]. ICF codes related to condition-specific ICF items, such as the codes for osteoarthritis and other chronic conditions, were selected in the development of ICF Core Sets [2,10]. This developmental effort facilitated condition-specific selection of ICF codes, but the ICF codes selected for one chronic condition may not necessarily be adaptable to other chronic conditions. The WHO provided the ICF checklist as a simple version of the ICF; however, the broad and vague definitions of the ICF codes used in the checklist limit its use in a target population such as elderly patients, because some ICF codes do not have high reliability for the intended population [4,5].

An alternative approach is to create linkage between the ICF and existing measures of activities of daily living (ADLs) and health-related quality of life (HRQOL) [2,11]. This approach has allowed ICF users to tailor the number of ICF categories to fit specific clinical needs [12,13]. This approach has qualitatively linked the ICF codes to existing ADL limitation-related scales such as the Functional Independence Measure (FIM) [14]. However, in these cross-linking approaches, the absence of quantitative links limits the use of the ICF for measurement scales.

Some studies have tried to link the existing scale to the ICF codes quantitatively [15-17]. An example of such a linkage has been established between the *Typology of the Aged with Illustrations* (TAI) and the ICF [18,19]. The TAI contains four Guttman-type scales for Mobility, Cognitive functioning, Eating, and Toileting. Each scale includes five thresholds that enable staging of the functioning of elderly persons. For example, the following five items are used as thresholds in the TAI mobility scale: threshold 5, "stair climbing"; threshold 4, "walking short distance"; threshold 3, "moving around on a flat floor"; threshold 2, "transferring, maintaining sitting position" and threshold 1, "rolling over on beds". A Guttman scale is composed of a set of binary items with yes or no answers, with similar content, but differing in difficulty. In this case, items are arranged in order of difficulty so that an individual who performs a particular item also performs items of a lower difficulty rank-order. However, it has been shown that some items used in a TAI scale are not in the order of difficulty when they are assessed with the Rasch model [19].

Another approach is the proposed functional staging measurement. In this measurement, sets of items are used to construct scores; which are then converted into hierarchical stages using cut-off scores. Functional staging provides a detailed description of an individual's expected ability within each identified stage, including the types of activities he or she can do. This is achieved by cross-linking Activity Measure for Post-Acute Care (AM-PAC) items to the ICF [5]. However, the items used on the AM-PAC are numerous and are not always linkable to the ICF codes. For example, "Fastening a necklace (clasp) behind your neck" is difficult to code in terms of the ICF.

Therefore, in this study, the authors constructed a Guttman-type scale using the response pattern of the ICF items analyzed by the Rasch model. If we could successfully build such a scale starting from ICF codes, we could obtain a simple scale with a staging property.

The Rasch model assumes that the probability that a person will fit into a category within an item is a logistic function of the difference between the person's ability (θ) and the difficulty of the item (b) [20]. The probability of success (or failure) of an item or a task is a binary item (such as failure or success in transferring from a bed), and can be expressed as

$$Pi(\theta) = \frac{e^{(\theta - b_i)}}{1 + e^{(\theta - b_i)}}$$

where Pi (θ) is the probability that respondents with ability θ will answer item i correctly (or be able to do the task specified by that item i). From this formula, the expected pattern of responses to an item set is determined given that estimated θ and b.

If the items with a binary response pattern fit the Rasch model, they provide a Guttman-like response structure. For this purpose, we used a binary-type response for each ICF item in this study. In the Rasch model, the Guttman response pattern is the most probable response pattern for a person when items are ordered from least difficult to most difficult. Using these characteristics of the Rasch model, we used the item fitted to the Rasch model as a threshold item in the Guttman-type scale. Therefore, selected ICF items are used as the thresholds for the boundaries between categories. Using this property of the Rasch model, we constructed two Guttman-type scales that can be used as a staging tool.

The objective of our study was to construct Guttman-type scales with the ICF codes for use in geriatric care settings. The goal was to be able to use the scales to assign patients to one stage. Staging of the functional levels of patients enhances standardization of care, helps in the planning and development of health services, and allows for communication among health services professionals concerning patients' functional capabilities. Therefore, we decided to construct a new ICF-based staging system, starting from ICF codes, rather than linkage from an extant measure, and to find a link to the ICF. This study departed from measurement of the ICF codes themselves. Using the results, we reconstructed a new measurement tool to stage the functioning of elderly persons.

Methods

Item selection and assessment

We selected 19 items related to mobility, walking, and transfer based on a previous study on reliability [4]. The 19 items were then modified into 33 items which specified performance in relation to mobility, walking and transfer. We divided the 33 ICF codes into 12 "basic mobility"-related items, and 21 "walking"-related items according to the meaning of each code. These modified items were labeled differently from the original items compared with the labeling used in the study. For example, the ICF code "Maintaining a standing position (d4154)" was divided into "Maintaining a standing position with assistance (d4154a)" and "Maintaining a standing position without assistance (d4154b)." The modified or specified ICF codes are shown in Additional file 1. All ICF items are attached with illustrations [21].

Participants

In this study, we recruited two groups, one for scale development, and another for scale validation. For both groups, elderly persons over 65 years old were recruited. For scale development, Japanese elders from 14 institutions and 14 day care-services under the auspices of long-term care insurance (LTCI) were recruited. Each facility was asked to randomly select 10% of their users. The developmental sample was measured with the 33 ICF items.

For scale validation, data from 182 institutions and 177 day care centers were collected. Each facility randomly selected 10% of their patients for participation in the study. The ICF items selected by the scale development process and the newly constructed Guttmann-type scale were measured in this sample.

Each patient was measured with respect to each ICF item according to performance (whether or not the participants do a task as part of their daily activities) or capacity (whether or not the participants could do the task in a special or "standard" environment setting such as in a rehabilitation room). The performance results were used in this study. We did not use the 0-4 generic qualifier of the ICF. Each item was assessed/rated "yes" or "no" using the binary response options to construct a Guttmann-type scale.

The assessment was based on the observation of the daily activities in a geriatric health facility. For example, in the assessment of maintenance of sitting position, the authors did not specify the duration of maintenance of such activity unless specified otherwise, but if the elderly person was capable of maintaining a sitting position regularly, the assessor checked "yes" to this item.

The assessment was performed by trained health care professionals such as physiotherapists, occupational therapists, nurses, and certified nursing aides, who also had experience in geriatric health assessment. In addition, the health care professionals were given training by the authors on how to make the assessments using each ICF item.

Written consent to participate in this study was obtained from each participant or the participant's proxy family member. The study was approved by the Ethical Review Board of the Japanese Association of Geriatric Health Services Facilities, and is in compliance with the Declaration of Helsinki.

Data analysis

The characteristics of the sample and contrasts between the variables were analyzed using SPSS version 12.0 (IBM Corporation, Armonk, NY, USA). Rasch analysis was performed with RUMM2030 (RUMM Laboratory Pty. Ltd., Duncraig, WA, Australia). The Rasch model was employed to identify item-fitting and redundant items and to identify a hierarchy of mobility items ranked from easiest to hardest. For this analysis, a sample of 300 items was randomly selected from the eligible sample for scale development (n = 1164). If we use the total sample, most of the items appear to not fit the Rasch model because fit statistics are sample size dependent and as the sample here is relatively large. Therefore, all items would be significant and not fit the model unless a smaller random sample is selected [22]. Thus, taking into account the relationship between sample size and significance of mean-square statistics, the authors decided to use the sample size of 300 [23].

The ICF items that showed a low fit to the Rasch model were deleted iteratively until the remaining items reached an acceptable item fit (selection criteria $P > 0.05$). The iterative process is not shown in this paper. Of the items that showed a closer fit to the Rasch model, four items (out of 12 items) for basic mobility were selected, and four walking-related items (out of 21 items) were selected. A panel of health care professionals, including a physician, nurses, nursing aide, physiotherapist, and occupational therapist, reviewed the items selected after statistical selection of the items. If we had more than four items that fit the Rasch model, then the panel members chose the final item based on its applicability in daily care settings.

Then, two Guttman-type scales namely "basic mobility" and "walking" were constructed using the four ICF items selected for each scale, and illustrations were attached. Using the sample for scale validation, the threshold location of the newly developed scale was tested against the ICF items to see whether the order of the threshold was in order of difficulty for each ICF item. In addition, differential item functioning (DIF) for study location (day care and institution), sex and age-group (under 74 years, 75 to 84 years, 85 to 94 years and over 95 years) was tested for scale validation [24].

Results

Among 1560 potential study candidates from the sample for scale development, 1164 were eligible for this study. A total of 396 participants were excluded due to missing data. Those persons with missing data did not differ significantly in terms of sex, age group and study location, according to the chi-square test. The average age of the candidates in the eligible sample was 84 (SD 8) years, and 222 (19%) of the study subjects were men. Of these, 313 (27%) elderly persons were living at home and assessed while using a day care service. The participants in the remaining sample were institutionalized elderly persons.

Tables 1 and 2 show the location and fit statistics of the initial items tested. Of these, 12 items were selected which further described basic mobility. From Tables 1 and 2, we re-analyzed the remaining items until we selected the best items that fit the model. These items were then rearranged as a Guttman-type scale according to their item difficulty, as shown in Figures 1 (mobility scale) and Figure 2 (walking scale). Illustrations are attached to show the image for each ability level.

In the present study, the authors reduced the number of items by constructing Guttman scales in combination with Rasch analysis. An example of a basic mobility scale is shown in Figure 1. This Guttman-type scale is composed of 4 ICF items that were used as thresholds. The levels between the thresholds are labeled, and illustrations have been added to clarify each level. For example, as seen in Figure 1, stage 1 of the basic mobility scale is not being able to change in and out of a lying position independently. If the person is able to change position but does not maintain a sitting position, they are assessed as stage 2.

We tested the characteristics of the newly developed scale using the sample for scale validation. There were 1706 elderly persons using an institutional service (average age, 85 years) and 1554 elderly persons using a day care service (average age, 81 years) from whom we obtained the data for validation. There were more institutionalized elderly persons in the sample for scale validation, but the percentage according to sex did not differ significantly between the two groups. For the age category, the sample for validation was younger (average age, 82 years) compared with the sample for development (average age, 84 years) because the former included more elderly persons in the age group between ages 64 and 75 years.

Figure 3 shows the location of the ICF codes with respect to the new scale. The item difficulty (location) was found to be in the same order as the ICF codes selected to construct the items. No DIF was observed for study location (institution or day care), sex, or age groups (see Additional file 2).

Discussion

The ICF-based classification developed in the present study has wide applicability. First, patients can be

Table 1 Item locations and fit statistics for basic mobility

ICF code	Item related to body movement and body posture	Location	Fitness	p-value
d4100	Lying down	−1.53	4.87	0.09
d4103	Sitting	−0.86	3.56	0.17
d4105	Bending	−0.16	1.40	0.50
d4106	Shifting the body's center of gravity	0.80	9.16	0.01
d415	Maintaining a body position	−3.29	0.82	0.66
d4153a	Maintaining a sitting position without assistance	−0.33	3.33	0.19*
d4154a	Maintaining a standing position with assistance	1.84	3.48	0.18
d4154b	Maintaining a standing position without assistance	3.51	3.64	0.16*
d420	Transferring oneself	0.38	22.29	0.00
d4200	Transferring oneself while sitting	0.07	3.76	0.15*
d4201	Transferring oneself while lying	1.92	5.08	0.08
d4208a	Changing lying position	−2.35	1.50	0.47*

*final items selected.

assigned to one stage in each scale. Staging offers standardization of rehabilitation and care management because patients of the same group in a certain level require a similar amount and type of resources. This was achieved by hierarchically rearranging the ICF items and constructing Guttman-type scales according to item difficulty.

This approach also provides the opportunity to analyze longitudinal changes in an elderly person's functioning. Based on the results shown in Figure 3, the item location of each sample as shown was used to develop this scale. As shown here, patient characteristics are demarcated by ICF codes not only qualitatively, but also quantitatively. The location of each threshold item used to construct staging is arranged in a logit model. If a patient improves from one stage to the next stage, then the amount of improvement can be estimated by the difference between the two items' locations. This means that the user can estimate patients' functioning levels and follow them quantitatively.

Results from our study can also be used to allocate resources, such as for rehabilitation. Figure 3 shows the initial ICF items plotted on the new scale in order of item difficulty. As shown here, the patients within a specific category may or may not be able to perform the tasks represented by the adjacent ICF items. Therefore, these items can be used as proxy targets for rehabilitation.

Some ICF tools, such as ICF Core Sets, have used the ICF codes separately. ICF Core Sets have been developed in the effort to make the utility of the ICF practical and feasible, particularly in clinical settings. Only selected ICF categories that were found to be relevant to a specific health condition, setting, or context are included in a Core Set. Our approach differs from most ICF Core-Set approaches because our method does not select patients by diagnosis. This is because, in sub-acute care settings such as nursing homes or rehabilitation care facilities, as well as in home care settings such as day care, patients are not divided by disease category. Some cross-

Table 2 Item locations and fit statistics for walking functions

ICF code	Item related to mobility and walking	Location	Fitness	p-value
d450a	Walking with assistance from a person	−1.93	29.66	0.00
d450b	Walking without assistance	1.12	3.14	0.21*
d4500a	Walking short distances (50 m)	−0.88	4.50	0.11
d4500b	Walking short distances (50 m) on flat floor	−1.50	13.92	0.00
d4502	Walking on different surfaces	1.55	1.91	0.38
d4503	Walking around obstacles	−1.87	12.87	0.00
d4551a	Climbing (climbing upstairs)	1.64	0.52	0.77*
d4551b	Climbing (climbing downstairs)	1.22	2.78	0.25
d4601a	Moving around within buildings other than home (in nursing home)	−4.23	1.44	0.49*
d4601b	Moving around within buildings other than home (not nursing home)	−0.50	6.57	0.04
d4602	Moving around outside the home and other buildings	1.36	2.82	0.24
d465a	Moving around using equipment (with cane)	0.11	5.39	0.07
d465b	Moving around using equipment (with cane and braces)	1.04	3.49	0.17
d465c	Moving around using equipment (with T-shaped cane)	−0.18	3.70	0.16
d465e	Moving around using equipment (with four-point cane)	1.30	2.27	0.32
d465f	Moving around using equipment (with walker)	−0.43	3.67	0.16
d465g	Moving around using equipment (with circled-type walker)	1.55	2.05	0.36
d465h	Moving around using equipment (with wheelchair)	−2.42	187.31	0.00
d465i	Moving around using equipment (with braces)	0.98	4.41	0.11
d4701	Using private motorized transportation	−0.96	6.93	0.03
d4702	Using public motorized transportation	3.04	1.16	0.56*

*final items selected.

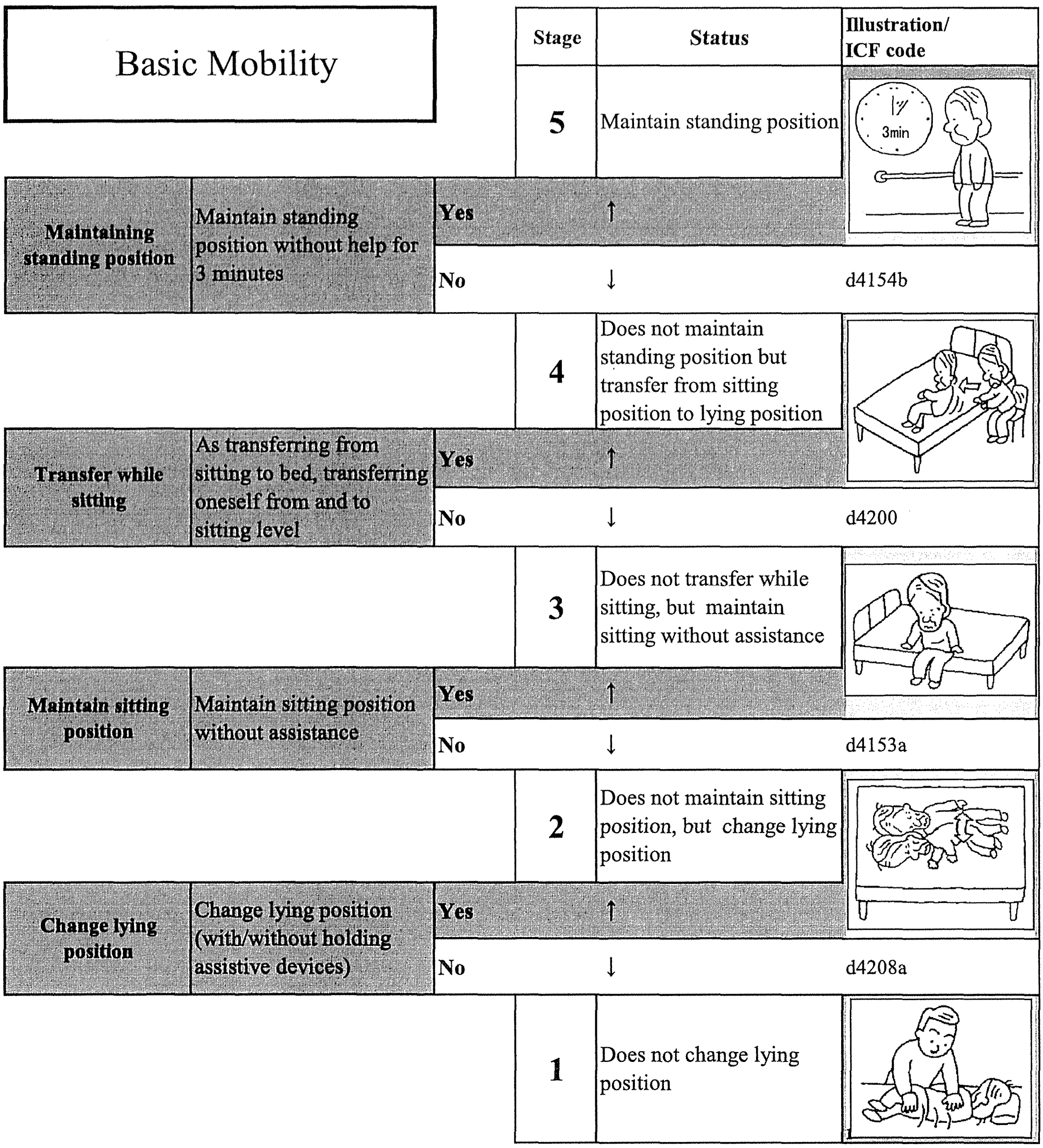

Figure 1 Basic mobility scale.

group difference was analyzed using DIF analysis and no DIF was found between the elderly persons in institutions and day-care facilities, which implies the applicability of this method for both settings. In addition, the scales can be used as a classification system because they have staging properties. By adding illustrations to the scales, a clear image concerning basic mobility and walking can now be obtained for each patient.

Our study does have some limitations. First, the location statistics of two ICF items used as thresholds, namely, 'Going out using public transportation (d4702)' and 'Climbing up stairs (d4551),' were very near each other, which results in weak discriminative power, as shown in Figure 3. This was also evident in the newly developed mobility and walking scale. 'Going out using public transportation' may require not only mobility

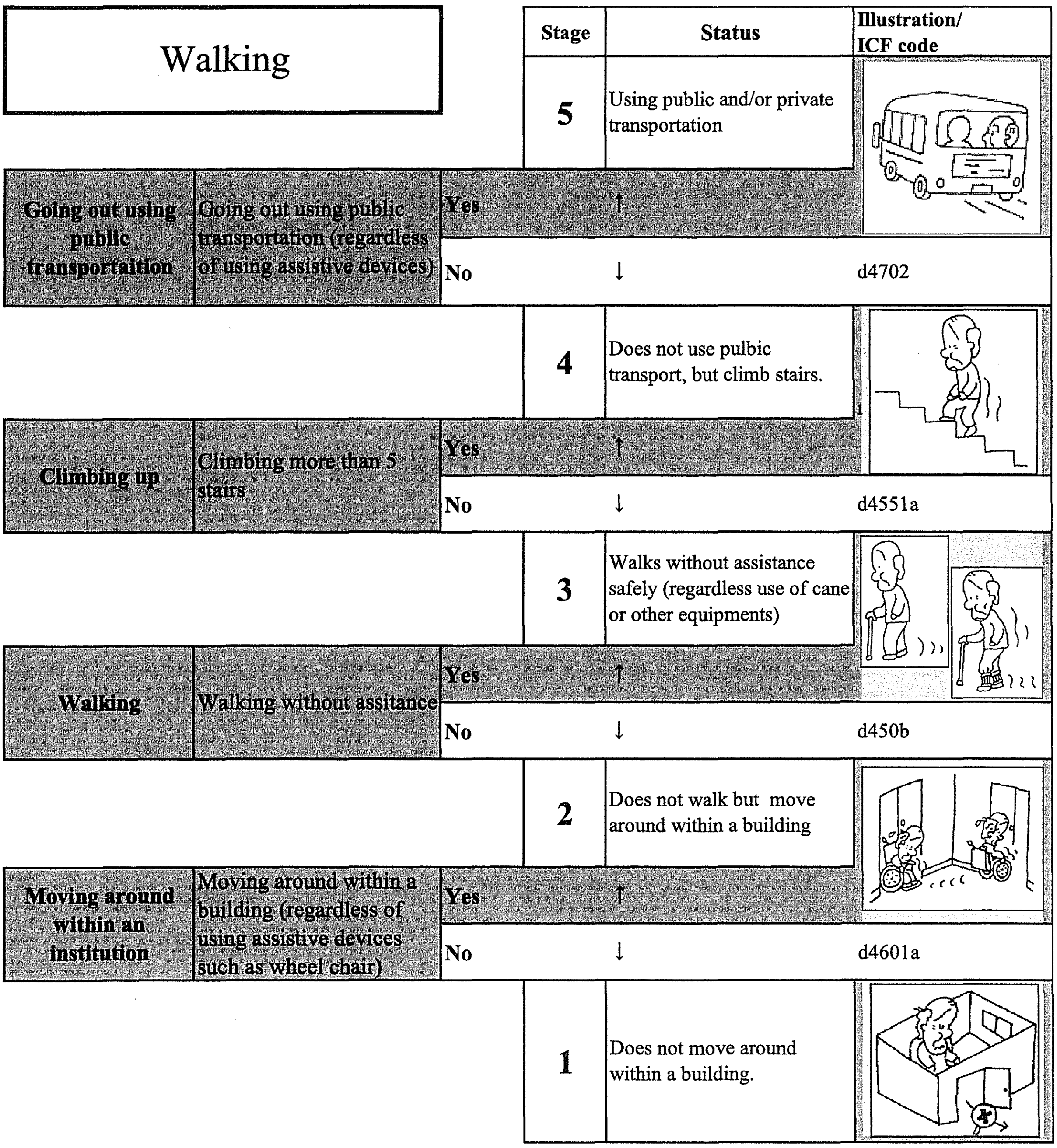

Figure 2 Walking scale.

functioning, but also adequate cognitive and orientation functioning. However, we retained this item in this scale, because for the elderly living at home, this skill is important for staying active in society. Second, we could not use the exact ICF codes because the ICF itself does not provide code definitions applicable or specifically intended for the geriatric setting. Therefore, we had to attach associated words to fit the geriatric care setting such as "Maintain sitting position without assistance" and "Walking without assistance". Third, our study population is Japanese, which could limit the applicability of our findings to other types of patients, settings, geographical locations. Furthermore, our study was conducted in a government long-term care facility, which may impact the use of certain assessment instruments in other populations.

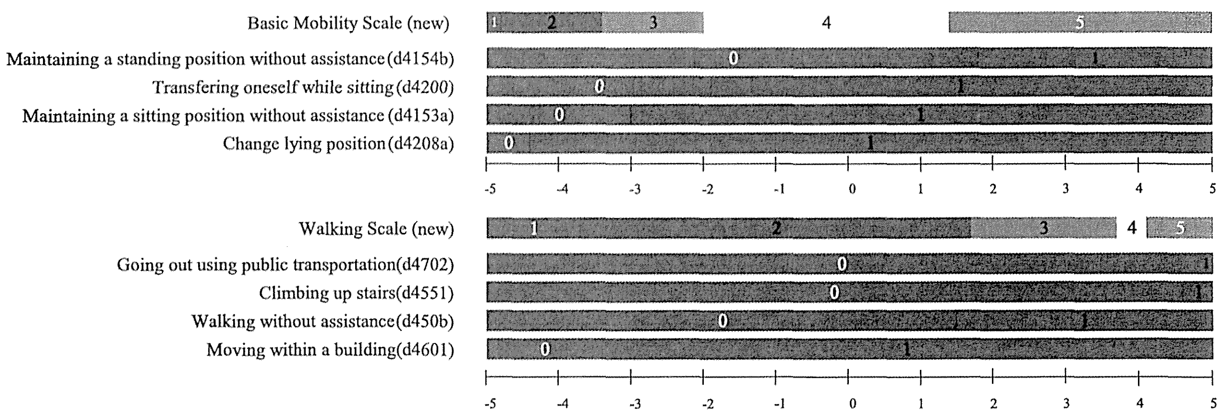

Figure 3 Threshold distribution of new scales and original ICF items. The borders of levels between 1, 2, 3, 4, 5 of the Basic Mobility and Walking Scale represent the locations of the threshold levels in logit. The border (0 and 1) of each ICF code represents the threshold of whether the person performed the task (=1) or not (=0).

However, the scales we have developed satisfy content validity, because items were selected from a broad spectrum of mobility and walking. In addition, by dividing the items into the categories of basic mobility and walking, and allowing each item to have a closer fit to the Rasch model, the scales are likely to be both measuring a single dimension with different difficulty and satisfying the construct validity. Use of expert opinions to help selecting items for the scale also adds validity. However, further supporting evidence through subsequent studies will need to be considered.

The absence of differential item functioning across institutional and day care users, sex, and age group indicates the cross-group validity of the scale. Therefore, these scales may be ready for use as assessment scales in geriatric care settings. In addition, we can now better understand and manage patient care using functional information based on the ICF. As we used ICF as a basis for our taxonomy, these scales may be used internationally. However, the contextual difference in language across countries should be taken into account for international application.

Furthermore, aspects such as test-retest reliability and both concurrent and predictive validity are also essential elements of outcome measurement. Hence, these would need to be examined in future studies. Using the same methodology, ICF-based staging scales relating other aspects of ADLs, such as eating and toileting, as well as cognitive functioning and social participation, are under development.

Conclusions

We have developed two simple staging scales for basic mobility and walking based on the ICF for elderly persons. Using these scales, patients are assigned to one stage in each scale. This was achieved by hierarchically rearranging the ICF items and constructing Guttman-type scales according to item difficulty using the Rasch model. These scales facilitate objective, simple and clear descriptions of elderly functional levels thereby improving the ability to use as a comparable assessment and staging tool. In addition, each functional level might require similar resources and therefore enable standardization of care and rehabilitation. Illustrations facilitate the sharing of patient images among health care providers. The authors are currently performing additional validity and reliability studies to enable the scale to be used in international geriatric care settings.

Additional files

Additional file 1: Items used in this study, with or without modification.

Additional file 2: Differential item functioning for study location, sex and age-group.

Competing interests

JO TT and TK are involved in the development of ICF-based care-management systems (R4 system). for the Japanese Association of Geriatric Health Services Facilities (JAGHSF) in which this ICF based staging will be used. JO TT and TK received travel expenses to develop this care-management system. However, JAGHSF is a not-for profit organization aiming at quality improvement of the member facilities. Therefore the authors declare no competing interests.

Authors' contributions

JO: conception and design, analysis and interpretation of data, preparation of the manuscript; TT and KT: acquisition and interpretation of data, revision of the manuscript; RE: interpretation of data, revision of the manuscript. The final version of the manuscript was approved by all authors.

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IV. 生活習慣病と認知機能—予防と治療—

アルコール

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Alcohol-related dementia

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Abstract

Excessive alcohol use is associated with health problems for the elderly in combination with their chronic conditions. One such complication, alcohol-related dementia (ARD) is brought about by direct or indirect ethanol intoxication, and coexisting nutritional deficiency, liver disease, cerebrovascular disease and traumatic brain injury. The elderly people with ARD have been underestimated and underdiagnosed. In these older alcoholics, atrophic changes, lacunar infarcts and deep white matter lesions of the brain are evident and are associated not only with their cognitive decline, but also with their frailty, leading to high morbidity and mortality ratio. Although lifelong abstinence can recover patients with ARD to temporally lull, aging, the severity of alcohol dependence, and the concomitant nutritional, physical and environmental factors can all impact negatively their outcome. Therefore, a comprehensive approach to lifestyle factors is recommended so that they can minimize preventable risks and maintain health status. Nursing home placement may be an appropriate treatment option for some refractory, long-term patients with ARD.

Key words: alcohol-related dementia, Korsakoff's syndrome, alcohol drinking in moderation, elderly people

はじめに

世界保健機関によると飲酒は60以上の疾患の発症に関与するとし，飲酒量の増大のみならず飲酒年齢の若年化や女性アルコール問題にも警鐘を鳴らしている．しかし一方で適度な飲酒は体に良いと流布している．これまでに多くの観察研究で1日2ドリンク(純アルコール換算で20g)程度までの飲酒量でmortality ratesが一番低いことが示されてきた．この量はビール500mL，日本酒だと1合に相当する．しかし，飲酒量が増えるにつれmortalityにかかわる健康被害は増大する．この飲酒量とmortality ratesとのJカーブの関係は，‘健康日本21’の‘節度ある適度な飲酒’量を設定する根拠となった[1]．それでは，飲酒量と認知症発症との関係

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はどうであろうか．飲酒とmortalityとの関係がそのまま当てはまるのだろうか．また認知症の予備軍である高齢者にはどういった飲酒指導が推奨されるであろうか．

1. 飲酒とJカーブ

1) 飲酒量と総死亡率あるいは各疾患との関係

飲酒とmortality ratesにはJカーブの関係がある．これは日本を含む世界各国における前向き研究において明らかにされてきた．すなわち，少量飲酒者を縦断的に観察した場合では非飲酒者に比べmortality ratesが低いというものである．最近の34研究を合わせたメタ解析でもJカーブの関係が確認された[2]．ここでは，約100万人の男女のデータを解析し，男性では1日アルコール2ドリンク(20g)程度，女性では1ドリンク程度では，mortalityに対して利点があり，少量飲酒の最大のリスク低減の効果は男性で17%(99%信頼区間[CI]：15-19%)，女性で18%(13-22%)であった．このように少量飲酒でmortality ratesが下がっているのはJカーブの関係を示す主要疾患である虚血性心疾患の効果が大きく反映されていると考えられている．そのほか，脳梗塞，2型糖尿病などがこのパターンをとる疾患として知られている[3]．

Jカーブが一人歩きをした感があるが，すべての疾患がこのJカーブを取るわけではない．飲酒量と健康リスクが正比例関係にある($y=kx$)パターンもあり，高血圧，脂質異常症(高中性脂肪血症)，脳出血，乳がんがこれにあたる．また，飲酒量の低いうちはリスクの上昇がなく多くなると急激にリスクが高くなる($y=kx^2$)パターンはアルコール性肝硬変の特徴である．

2) 飲酒量と認知症との関係

a. 飲酒と認知症発症について

認知症と飲酒量との関連について，2000年までのメタ解析で少量飲酒と認知症発症には関係がないとされてきた．その後，認知症発症低減効果があるとの大規模な前向き研究が相ついで発表された．Mukamalらは，約5,900人のCardiovascular Heart Studyの参加者を平均6年間追跡し，1日あたり純アルコール換算で2-12g(ビールで350mLを週に1-6本)の飲酒者で最も認知症になる危険性が低く，オッズ比が0.46(95%CI: 0.27-0.77)であったと報告した[4]．最近の23研究を合わせたメタ解析では少量飲酒に認知症のリスク低減効果が認められ，全認知症においてrisk ratio(RR)が0.63(95%CI: 0.53-0.75)，アルツハイマー病では0.57(0.44-0.74)，脳血管認知症では0.89(0.67-1.17)と報告している(図1)[5]．少量飲酒の認知症に関与するメカニズムとしてHDLコレステロール増加作用，フィブリノーゲン低下作用，内因性エストロゲン活性化，また特にワインにおけるポリフェノールやレスベラトロールの抗酸化作用などが挙げられる．

b. 飲酒と画像所見

健常高齢者において習慣飲酒は脳血管障害の危険因子である[6]．自験例では，65歳以上の健常者を対象にした住民検診でMRI画像上の径5mm以上の無症候性脳梗塞の頻度は約25%であり，その危険因子は年齢・高血圧・喫煙・飲酒・男性・血漿ホモシステイン値であった．また瀧らによる高齢者住民の調査で生涯アルコール飲酒量とMRI上の脳容積には逆相関が認められ，特に中前頭回領域で顕著であった[7]．つまり脳画像上，脳血管障害・脳萎縮ともに飲酒量との関係はJカーブではなく，飲めば飲むほど悪化するという負の相関にある．

2. アルコール依存症者の認知機能とその画像所見

1) アルコール関連認知症(alcohol-related dementia)

上記のごとく少量の飲酒は認知症のリスクを低減する可能性があるが，画像上のfavorableな効果は(少量であっても)認められない．我が国における純アルコール換算1日60g(日本酒で3合)以上の多量飲酒者は860万人，アルコール依存症者は80万人と推定されるが[3]，これらの者が将来飲酒による認知症発症抑制の恩恵を受けるはずはなく，年齢とともに認知機能低下をきたすことになる．

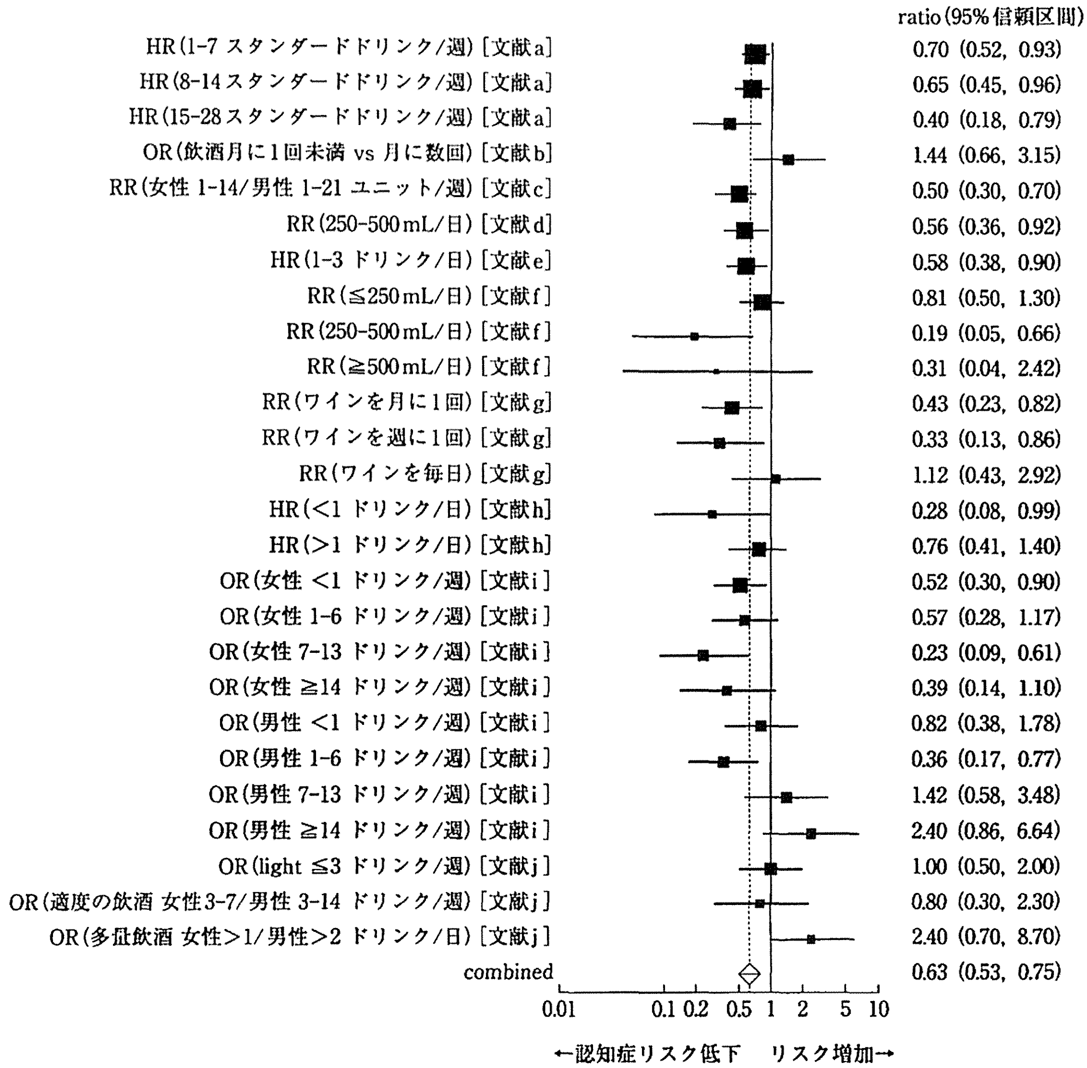

図1 最近の少量飲酒と認知症リスクに関する研究(23研究)のメタアナリシスプロット
(ランダムイフェクトモデルによる)(文献[5]より改変)

HR: hazard ratio. RR: relative risk. OR: odds ratio. 文献a: Simons LA, et al: Med J Aust 184: 68-70, 2006., 文献b: Anttila T, et al: BMJ 329: 539, 2004., 文献c: Huang W, et al: J Clin Epidemiol 55: 959-964, 2002., 文献d: Larrieu S, et al: J Nutr Health Aging 8: 150-154, 2004., 文献e: Ruitenberg A, et al: Lancet 359: 281-286, 2002., 文献f: Orgogozo JM, et al: Rev Neurol(Paris) 153: 185-192, 1997., 文献g: Truelsen T, et al: Neurology 59: 1313-1319, 2002., 文献h: Espeland MA, et al: Am J Epidemiol 161: 228-238, 2005., 文献i: Mukamal KJ, et al: JAMA 289: 1405-1413, 2003., 文献j: Jarvenpaa T, et al: Epidemiology 16: 766-771, 2005.

高齢アルコール依存症者では認知機能低下が一般的であり，断酒入院患者に認知機能のmini-mental state examination(MMSE)を行うと，60歳代で既に認知症の初期段階にある(図2-a)．これはアルツハイマー病の平均発症年齢より10歳も若い．頭部MRI上，萎縮性変化(前頭葉萎縮や脳室(側脳室，第3，4脳室)拡大・脳溝の開大など)が認められ，高齢者では脳梗塞・深部白質病変が顕著になる(図2-b)．梗塞の頻度は60歳代で50%と，健常高齢者の3-4倍の頻度にのぼる(図2-c)[8,9]．著者らの施設において，アルコール依存症者約1,500症例

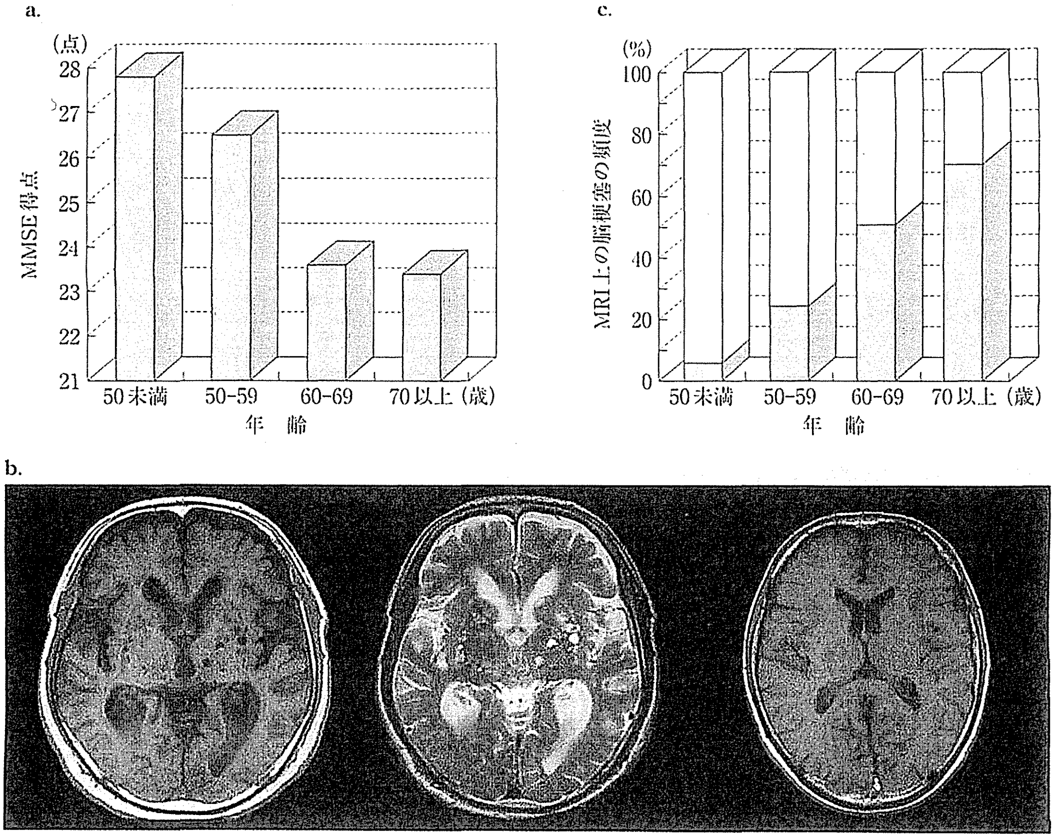

図2 アルコール依存症者の認知機能と頭部MRI上の脳梗塞の頻度

(久里浜医療センターのアルコール症患者242人の調査)

a. アルコール症では50歳代で既に軽度認知機能障害(26.5点)を認め，60歳代では認知症の初期状態の得点(23.5点)である.

b. 入院時63歳の男性. 60歳で定年退職し，その後大酒が習慣化. 次第に酩酊時の転倒，失禁，歩行異常がみられるようになり入院. MRI上(左と中の画像)は基底核を中心とした小梗塞が多発. 深部白質にはT2高信号が散在しているパターン. MMSEは25/30と境界レベルであった. 右のMRI画像は61歳の健常者の対照画像.

c. 頭部MRI上，60歳代では既に半数の患者において脳梗塞が認められる.

のMRI所見の検討では，脳挫傷や硬膜下血腫は3.5%に，認知機能に関係する視床・被殻の出血性病変も3.5%に，外傷後水頭症様の所見も1.9%に認められる. 重度肝障害をうかがわせるT1強調画像での淡蒼球の高輝度は19%に上る[10]. このようにアルコール関連認知症の本体とは，アルコール多飲という脳血管および脳萎縮に対するリスクの長期の曝露に加齢変化が加わったものを素地としている.

2) コルサコフ症候群とその画像所見

コルサコフ症候群(Korsakoff's syndrome: KS)は記銘力障害・見当識障害・作話を特徴とする代表的なアルコール関連認知症である[11]. 原因はアルコールそのものではなくビタミンB_1(VB_1)欠乏であるが，KSの多くはアルコール依存症者が占める. これはアルコール依存症がしばしば食事も摂らずに連続飲酒となることに起因する. KSはウェルニッケ脳症(Wernicke's encephalopathy: WE)の残遺症状ととらえられており，一般にウェルニッケ-コルサコフ症候群(Wernicke-Korsakoff syndrome)としても呼びならわされる.

WE/KSは栄養失調やVB_1不添加の長期の末梢補液によっても発症する. しかし，アルコー

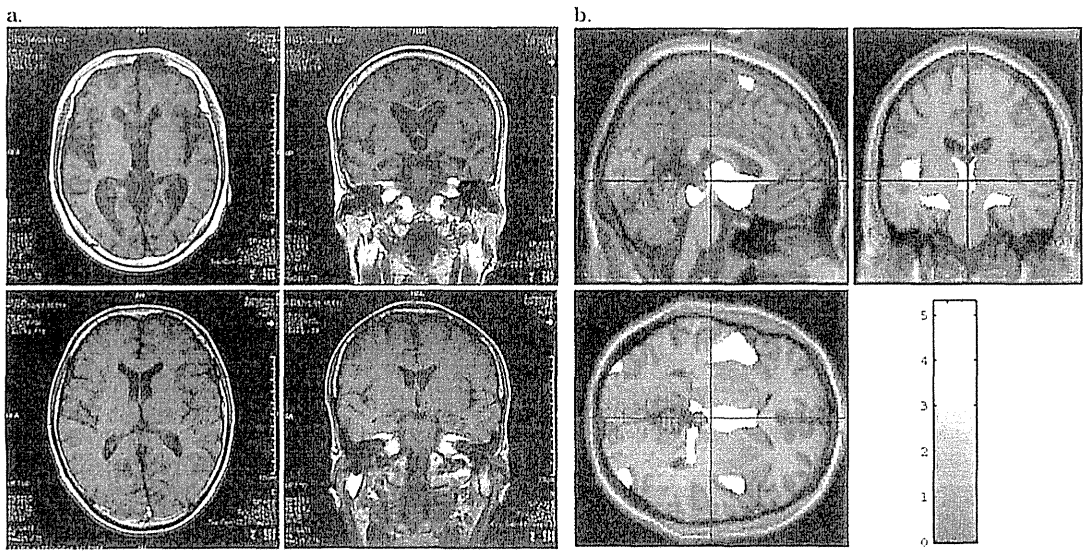

図3 コルサコフ症候群の画像所見

a. 58歳コルサコフ症候群患者のMRI(上段)：61歳健常者(下段)と比べ，脳室拡大，皮質の萎縮が顕著である．
b. コルサコフ症候群55人と合併症のないアルコール依存症患者58人での脳萎縮の相違をSPMで解析：視床近傍の第3脳室の開大と海馬周辺の萎縮が検出される．

ル依存症者でその発症が多いのは，以下のような理由により実質的なVB_1欠乏が生ずるためと考えられている．

1) 食事摂取不良
2) アルコールの消化管障害による吸収不良
3) アルコール分解にかかるVB_1必要量の増加
4) 肝機能障害によるVB_1貯蔵能の低下
5) マグネシウム不足による，VB_1の活性化の低下，などである．

VB_1は，糖質エネルギー代謝の重要な補酵素であり，その欠乏でピルビン酸脱水素酵素・αケトグルタル酸脱水素酵素・トランスケトラーゼ活性が著明に低下する．こうした脳でのVB_1を介したエネルギー代謝の破綻が，GABAやアスパラギン酸の低下，NMDAレセプター介在の神経異常興奮や酸化ストレス—活性酸素による神経細胞障害につながるものと想定されている．

KSは典型的には前述のごとく，WE発症後の慢性期の状態を指す．しかし，不顕性(subclinical) WEの存在も示唆されている．Blansjaarらによれば臨床上KSと診断された患者のうちWEを事前に診断されたものは18％にすぎないと報告している[12]．また生前WEが診断されなくても病理所見上WEが確定診断される症例があり，subclinical WEやunrecognized WEの存在を一層裏づける．

KSの診断には，認知機能検査，頭部MRIを行う．アルコール依存症者では前述のごとく頭部MRIで前頭葉萎縮や脳室(側脳室，第3，4脳室)拡大が認められるが，これはアルコール依存症者一般の所見でありKS診断としての特異性は少ない(図3-a)．一方，感度・特異度が高く，かつ病理学的な裏づけがあるのは視床や乳頭体の萎縮であるが，肉眼での萎縮の判断が難しい点がある．そこで，アルコール依存症者を認知機能低下のある群(55人)とない群(58人)，更には健常対照群(60人)をリクルートしたうえで，T1強調3次元volumetric magnetization prepared rapid gradient(MPRAGE)撮像を行い，voxel-based morphometry(VBM)とstatistical parametric mapping software(SPM)による，画像の半自動的処理による皮質領域の抽出と解析者のバイアスの極力入らない解析を行った．す

ると，アルコール依存症患者では対照群と比較して，広範に皮質領域・白質領域の萎縮が認められ，年齢とその体積は逆相関した．アルコールそのものが関与する領域として，前頭葉・大脳縦裂・シルビウス裂・小脳の萎縮が顕著であった．一方，認知機能低下群では，海馬・海馬傍回の萎縮が特徴的で，視床・第3脳室の萎縮が認知機能の低下のないアルコール依存症者に比し増強していた(図3-b)．海馬・海馬傍回の萎縮は肉眼上，下角の開大として認識可能であり，アルコール依存症者における認知機能低下に関与する画像診断として有用と考えられる[13]．

3. 高齢者と飲酒

1) 高齢者における飲酒問題の特徴

アルコール依存症者でなくとも高齢者の約15％に飲酒が関連した何らかの健康問題があるといわれ，アルコール関連認知症につながる予備軍の裾野は広い．また，アルコール関連認知症は健康寿命にかかわる重大な疾患としてもとらえられる．脳血管障害そのものが，転倒・肺炎にもつながり[14]，寝たきりを生ずる4大疾患が，骨折転倒・廃用症候群・脳血管障害・認知症であることを考えると，多量飲酒はどの疾患にも直接・間接に関与することが想像できる．

高齢者では，lifestyleの変容が飲酒の意義を変質させ，飲酒そのものが目的となる．すなわち，かつては仕事上の付き合いなど社会や共同体といった結びつきを保ちつつ一定量に収まっていた飲酒が，退職や配偶者の死などによる環境の変化や外部社会とのかかわりの希薄化によって，社会生活上の潤滑油あるいは身体的・精神的ストレスの調整弁としての飲酒の役割が減った一方，飲酒の依存性の面が増大するということである[15]．さびしいから，することがないから飲むといった飲酒が更に日常生活を破綻させることになる．

2) 高齢者にとっての適量とは—Jカーブの問題点

前述のように少量と過度の飲酒では認知症のリスクへの関与が相反する．しかし，少量飲酒と認知症の関係では次のような問題点がある．

a. Jカーブの根拠は観察研究によるものである

少量飲酒と認知症低減効果の厳密な証明には，対象者を禁酒群と少量飲酒群にランダムに割り振ったrandomized trialが必須であるが，この種の研究はなく現実的に困難である．したがって，飲酒を推奨することによる認知症の予防効果も，現に認知症を発症している患者の飲酒による改善効果も証明されていない．

もう一つの問題は，たとえ前向き研究であっても原因(飲酒)と結果(認知症発症)における交絡因子の完全な除去が難しいことである．本当に少量の飲酒は認知症予防に直接作用するのであろうか．つまり，適度な飲酒は単なるactive lifestyleのマーカーであって，身体的にも精神的にも健康であることが重要なのではないだろうか．Thunらによれば，適度な飲酒者の特徴としてsocioeconomic statusが高いことを挙げている[16]．この場合，少量飲酒はsocioeconomic statusのマーカーである可能性がある．先の，Mukamalらの研究でも[4]，最も認知症のリスクが少ない飲酒量は1日あたり350mLのビール1本に満たない量である．

b. 非飲酒者と少量飲酒者のselecting bias

研究の中には，非飲酒者(non-drinker)の中に断酒者(former drinkerやquitter)を含めているものがある．この場合，健康問題などの理由で断酒している者もコントロール群に含まれ，少量飲酒の効用を過大評価する．もっともMukamalらの研究では，これらの断酒者を除外して飲酒と認知症との関連を解析している．しかし，ここでも既飲者/断酒者の認知症のリスクは非飲酒者と比べ1.3-1.4倍(統計上は有意ではない)であり，non-drinkerとquitterが同質ではないことを示唆する．

また，多くの研究で少量飲酒群の中身は健常な高齢者である．Karlamanglaらによれば，少量飲酒の恩恵は健常者に認められる現象で，健康問題を抱えている者にこの関連はないとしている[17]．そもそも，60歳代で発症しているアルコール関連認知症患者がこれらの前向き研究の対象となることはなく，Jカーブが適応される

対象は更に限られたものとなる.

c. 日本人を対象にした研究ではない

これらの少量飲酒と認知症との関係は欧米での研究を基にしており, 日本人に外挿可能か疑わしい. 久山町研究では飲酒は脳血管認知症の危険因子である[18]. 飲酒の与える影響は体格・年齢・性差のほか, 人種で異なる. 日本人の約40%程度は体質的に飲酒により'赤ら顔'になるアルコールに弱い体質である. これはアセトアルデヒド脱水素酵素をコードする遺伝子上のALDH2多型が特に関係している[19,20]. この場合, 神経毒でもあるアセトアルデヒドが体内に貯留しやすいため, 認知症における飲酒の許容量は欧米人と比べ少ない可能性がある.

d. 高齢者への飲酒指導について

randomized trialで少量飲酒の効用が証明されていない現状では, Jカーブの結果をもって個人の積極的な飲酒の推奨(認知症予防を含む)には使えないであろう. 先に述べたとおり画像所見では飲酒との間にJカーブの関係はない. むしろ, 少量飲酒の効用は, 習慣飲酒者に飲み方を提示し, 抑制(コントロール)させるためのものである[21]. したがって高齢者にとっての'節度ある適度な飲酒'も, 飲酒によって健康になるという性質のものではなく, 適量のお酒を飲める環境, すなわち適度な運動をし, バランスの取れた食事をし, 生き生きとした生活を送るための, lifestyle維持の観点から論じられるべきである.

おわりに

社会の高齢化に伴い, 今後もアルコール関連認知症患者が増大することが予想される. 更に, 核家族化が相まって高齢者のアルコール問題はこうした環境下で容易に発生し, しかも早期の対策が講じられない可能性がある. 社会ネットワークやセーフティーネットを強固にし, また高齢者の健全で安定したlifestyleを目指すべく, 本人の社会的活動や仕事の継続など社会基盤の整備, また高齢者の心理的・身体的また生活環境のサポートなど多職種が参加した包括的なアプローチが必要である.

さかのぼればアルコールの認知症への対処は, なってからではなく, なる前の予防につきる. 高齢者よりむしろ壮年期での'節度ある適度な飲酒'の啓発活動や酒害教育が必要である. 現在の不適切飲酒が高齢者になってからのアルコール依存症発症リスクとなり, 認知症をはじめとする多飲飲酒関連疾患に関与することへの理解を広めることが肝要である[22].

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