

Localized cerebral blood flow changes in response to ADL-related vitality in elderly patients with dementia using single photon emission computed tomography

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Abstract

Aim: To clarify the area in the brain related to responsible for vitality and volition.

Methods: We studied 123 outpatients (39 men, 84 women, 77.7 ± 6.7 years old) who visited the Center for comprehensive care on memory disorders in Kyorin University Hospital. No patients were prescribed with anti-depressants, anti-anxiety agents, psychomimetics, acetylcholinesterase inhibitors, Chinese herbal medicines or cerebrovascular circulation modifying drugs. Patients with frontotemporal dementia or depression were excluded. ADL-related vitality and volition was measured by a vitality index. Cerebral brain blood flow was measured by single photon emission computed tomography (^{99m}Tc -ECD SPECT). Relative blood flow changes were calculated by Statistical Parametric Mapping (SPM). Absolute blood flow changes were calculated by a three-dimensional stereotaxic ROI template on anatomically standardised ^{99m}Tc -ECD SPECT (3D SRT). Statistically significant correlations between semi-quantitatively measured scores of vitality index and blood flow changes in SPM and 3D-SRT were tested and displayed on a brain map.

Results: Analysis of relative and absolute blood flow showed that the common responsible area in the brain related to vitality was the frontal lobe, fronto-cingulate gyrus, temporal lobe, basal ganglia (caudate nucleus) and thalamus. Blood flow changes in the orbital gyrus were strongly correlated with vitality index specially in the frontal lobe.

Conclusion: ADL-related vitality is affected mainly by the blood flow in the frontal-subcortical circuit. However, deep white matter was also important to determine vitality and volition.

Key words: *Dementia, Vitality, Vitality index, SPECT, Deep white matter*
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特集 転倒・転落をめぐる

臨床医に役立つ易転倒性発見のための
「転倒スコア」

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臨床医に役立つ易転倒性発見のための 「転倒スコア」

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キーワード 転倒 予測技術 簡便性 実用性

はじめに

転倒・骨折は高齢者における寝たきり要因の第3位に位置付けられ、骨粗鬆症性骨折のなかで最も重い骨折である大腿骨頸部骨折は、その90%以上が転倒によって生じるとされている¹⁾。転倒は骨折を合併しなくても、数度の転倒を経験すると、意欲や日常生活動作能力(ADL)を低下させる²⁾。地域住民におけるADL依存の危険因子として、転倒は約2倍のリスクであり³⁾、転倒予防は寝たきり予防にきわめて重要である。

従来、転倒危険因子は、特定のフィールドで横断的、あるいは縦断的に解析されているが、抽出された危険因子は、身体的脆弱性、歩行機能の低下など共通の危険因子がある一方、めまいや痴呆(認知症)などは成績が一致していない²⁾。転倒は、内的要因である身体的側面と、外的要因である環境要因による複合的症候群と捉えられるが、後者は地域や文化的、生活習慣の側面により大きく異なる可能性もある。

従来の転倒危険因子は、病歴、現症、血液検査、生活能力などの簡便な検査、専門調査員による測定検査、特殊な機器を用いた検査などが

統一性なく調査され、一般健康診断に適応できるかどうかの観点に著しく欠けていた(表1)。本稿では、内外の文献的レビューをもとに、転倒ハイリスク者の早期発見の評価方法作成ワーキンググループの研究班によって完成した、簡易な転倒リスク予測表「転倒スコア」を紹介し、妥当性、有効性について述べる。

I. 「転倒スコア」作成の経緯と方法

平成14年度厚生労働科学研究費補助金効果的医療技術の確立推進臨床研究事業「転倒骨折班の合同討議で、内外のレビュー^{1,3)}から、筋力低下、バランス欠如、歩行障害、視力障害、移動障害、認知機能障害、ADL障害、起立性低血圧、加齢、転倒の既往、慢性疾患、薬剤、段差が転倒の必須項目として挙げられた。これらの項目の内容を被験者が具体的に質問表のみで理解し、かつ因子のもつ意味が変容しないよう議論を重ね、問診表を完成した(表2)。繰り返し再現性、季節変動などの基本的検討はすでになされ、良好な結果を得ている³⁾。

II. 全国多地域における「転倒スコア」の検討と下位項目の解析

平成16年4月～平成17年3月、全国7地域(浦臼町、仙台市、塩尻市、中之条町、多摩地区、香北町、相良村)の住民2,439名(男性932名、女性1,507名;76.3±7.4歳)に対し

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表1 測定方法の難易度で分けた、転倒の危険因子と測定技術

問診表などで可能な簡易な方法
<ul style="list-style-type: none"> ・老研式活動能力指標低下 (手段的ADL, 知的能動性, 社会的役割の13項目で構成) ・過去の転倒歴 ・環境要因: 照明不良, 障害物, 段差, 不適切な履物など (定量化が難しい)
特殊機器, 測定スタッフ, 医師の問診・診察などが必要な専門検査
<ul style="list-style-type: none"> ・歩行運動系 (関節症, サルコペニアなど) <ul style="list-style-type: none"> 歩行速度遅延: Timed up & go test, 10m歩行速度 バランス低下: 片足立ち試験, タンデム歩行 (タンデム位), 重心動揺計 下肢筋力低下: 踏み台昇降, 握力 (代用), DXA (筋肉量) 歩行全般の異常: 歩行診察, 3次元歩行解析装置 ・心血管系障害 (不整脈, 起立性低血圧など): 心電図, 自律神経検査 ・神経系障害 (痴呆, パーキンソニズムなど): 神経内科的診察 ・薬剤 (鎮静薬, 睡眠薬, 抗アレルギー薬, 降圧薬など): 服薬調査

(鳥羽研二: 転倒ハイリスク者早期発見における「転倒スコア」の有用性. 関節外科2006; 25: 720-724より引用)

表2 転倒スコア

質問項目	陽性頻度 (%)			有意差 (p)
	全体	非転倒者	転倒者	
1) 過去1年の転倒: 回答数2,395名で708例(4.7±1.0回/年)	29.6			
2) つまずくことがある	56.5	45.3	83.3	< 0.0001
3) 手すりにつかまらずに, 階段の昇り降りができない	50.6	45.0	63.8	< 0.0001
4) 歩く速度が遅くなってきた	65.2	59.2	79.6	< 0.0001
5) 横断歩道を信号が青のうちに渡りきれない	17.05	12.7	27.5	< 0.0001
6) 1kmくらい続けて歩けない	35.8	30.5	48.5	< 0.0001
7) 片足で5秒くらい立てない	38.6	32.5	53.2	< 0.0001
8) 杖を使っている	28.3	22.0	43.7	< 0.0001
9) タオルを固く絞れない	16.8	12.2	28.2	< 0.0001
10) めまい, ふらつきがある	32.4	24.7	50.6	< 0.0001
11) 背中が丸くなってきた	44.9	40.3	55.8	< 0.0001
12) 膝が痛む	47.3	41.1	62.3	< 0.0001
13) 目が見にくい	53.1	48.4	64.3	< 0.0001
14) 耳が聞こえにくい	42.5	39.1	50.7	< 0.0001
15) 物忘れが気になる	63.7	59.4	74.0	< 0.0001
16) 転ばないかと不安になる	45.8	37.0	64.8	< 0.0001
17) 毎日お薬を5種類以上飲んでいる	31.2	27.2	40.8	< 0.0001
18) 家の中で歩くとき暗く感ずる	11.4	8.5	18.3	< 0.0001
19) 廊下, 居間, 玄関に障害物	20.8	17.1	29.6	< 0.0001
20) 家の中に段差がある	69.1	68.9	69.5	0.79 (ns)
21) 階段を使わなくてはならない	27.7	27.5	28.2	0.74 (ns)
22) 生活上, 家の近くの急な坂道を歩く	33.3	33.6	32.5	0.60 (ns)

(鳥羽研二他: 日老医誌 2005; 42: 346-352より引用)

て, 問診表の意味を説明し, 調査の同意を得たのち, 自記式にて回答, 自記不可能な場合は調査員が聞き取り調査を行った。

解析は, ①過去1年の転倒歴を従属変数とし

て, 多変量解析を行った。②観察期間中の転倒歴を従属変数, 過去1年の転倒歴を含む質問項目を独立変数として多変量解析を行った。年齢, 性は強制注入した。

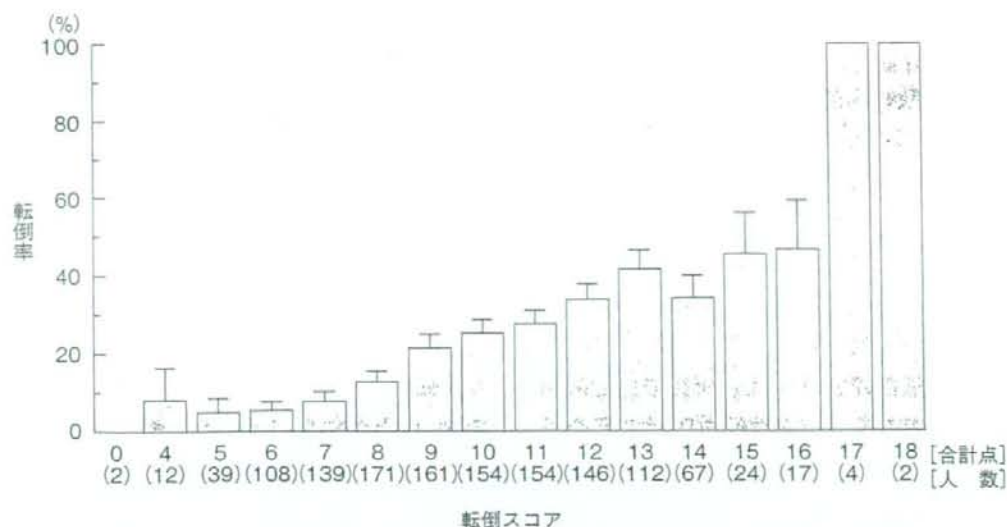


図1 転倒スコア21項目の陽性数の合計点(21点満点)と転倒率(過去1年)
(鳥羽研二他:日老医誌 2005; 42: 346-352より引用)

なお、 p 値が0.05未満を統計学的に有意とし、有意な傾向として、 $p < 0.1$ の項目も記載した。

Ⅲ. 主要な結果

各項目の出現頻度: 過去1年の転倒例は708名(男性229名, 女性479名, 平均年齢 77.5 ± 7.4 歳), 転倒率は29.6%, 観察期間中は25%であった。骨折は1.8%にみられた。質問項目と、過去1年の転倒者と非転倒者における下位項目を危険と判断する「陽性頻度」を表2に示す。

転倒スコア2)~22)項目の陽性数の合計点と転倒率を図1に示す。スコアが大きくなるほど転倒率が高くなることが示された。

観察期間中の転倒を評価しえた1,378症例で、観察期間中の転倒を従属変数としてロジスティック回帰分析を行い、独立した危険因子として抽出された下位項目の転倒危険度(オッズ比)を算出した⁴⁾。

独立した有意な危険因子として、過去1年の転倒歴($p < 0.0001$), 歩く速度が遅くなってき

表3 簡易式の「転倒チェック」シート

該当項目に✓を付ける	
<input type="checkbox"/> 過去1年に転んだことがある	5点
<input type="checkbox"/> 背中が丸くなってきた	2点
<input type="checkbox"/> 歩く速度が遅くなってきたと思う	2点
<input type="checkbox"/> 杖を使っている	2点
<input type="checkbox"/> 毎日5種類以上の薬を飲んでいる	2点
合計	点

※7点以上は「要注意」
(鳥羽研二他:日老医誌 2005; 42: 346-352より引用)

た($p = 0.04$), 杖の使用($p = 0.02$), 背中が丸くなってきた($p = 0.02$), 5種類以上の服薬($p = 0.03$)が抽出された。ロジスティック回帰分析におけるオッズ比は、過去1年の転倒が4.5倍と最も高く、次いで、歩く速度が遅くなってきた(1.9倍), 杖の使用(1.8倍), 背中が丸くなってきた(1.8倍), 5種類以上の服薬(1.7倍)であった。

これらのオッズ比を四捨五入して整数倍にし、重み付けした簡易式の「転倒チェック」シート(表3)の合計点を用い、観察期間中の転倒予測の有用性を検討したところ、カットオフポイント6/7点において、感度68%, 特異度71%の実用性に足る成績が得られた。

IV. 考察

転倒は、多数の内的要因、外的要因による多危険因子の重層的な症候群 (multiple risk factor syndrome) の1つである³⁾。

Rubenstein は、転倒に関する大規模研究のレビューを行ったところ、筋力低下、バランス欠如、歩行障害、移動障害、ADL 障害はほとんどすべての研究で一致した危険因子であるが、視力障害、認知機能障害は半数の研究では危険因子として有意でなく、起立性低血圧は7研究中2つのみ有意であった⁵⁾。このように、人種や地域の差異が比較的大きくないと予測される内的要因においても、危険因子としての重みは、対象によって異なる成績となる。

転倒の危険評価表の開発は、主として介護施設⁶⁾や病院⁷⁻⁹⁾で行われ、過去の転倒、認知機能、感覚機能、運動・歩行機能、薬剤、立ちくらみ、慢性疾患が危険因子として挙げられている。ところが、転倒の大部分は家庭内で、過半数は居間などの室内で起きるとされているが、外的要因に関して、危険因子を標準化する試みはほとんどない。地域における転倒危険因子の抽出は多く行われているが¹⁰⁻¹⁴⁾、機能評価は質問表のみで完了せず、測定に人手を要するものがほとんどである。また、内的要因と外的要因を公平に並べて、転倒の危険因子としての意味を調査した研究はなく、外的要因を加えた地域での簡易な危険因子評価表は見当たらない。

転倒スコアでは、過去の成績^{1,2,4)}、および転倒評価表ワーキンググループの研究成績から、内的要因の選択を行った。外的要因に関しては、筋力低下、バランス欠如、歩行障害、移動障害、ADL 障害と関連する外的因子に焦点を絞り、バリアフリーの観点から、障害物、段差、階段、坂道など多様な因子を下位項目に挙げた。視力障害と関連して、「部屋が暗く感じるか」も加えた。

転倒者と非転倒者を比較すると、転倒スコア

のほとんどの項目に有意差があったが、段差、階段、坂道に有意差はなかった。「転倒といえばバリアフリー」という短絡的な反応が間違っていることが初めて判明した。

転倒スコアは陽性点が高くなるほど転倒率が増した。また、本スコアの実用性に関し、松林らは転倒スコアを用い、北海道浦臼町で他の検査方法との比較を施行した。転倒を従属変数として、転倒危険を察知するカットオフポイントは、転倒スコア10点以上で、感度、特異度とも70%以上の結果であった。また、従来のTimed up & go testや、歩行速度、Functional Reachよりも転倒予測の感度、特異度に優れているという結果を得ている〔松林公蔵：平成18年度厚生労働科学研究費補助金長寿科学総合研究事業「効率的転倒予測技術の開発と転倒予防介入による生活機能の持続的改善効果に関する縦断研究」(主任研究者：鳥羽研二)報告書〕。菊地らは、もの忘れ外来において、将来の転倒予測に関し、片足立ち、タンDEM歩行、Timed up & go test、Functional Reach、握力などと比較し、多変量解析で、転倒スコアのみが独立した危険予測因子となる成績を得ている(投稿中)。

今回多変量解析で抽出された「転倒スコア」の下位項目は、筋力低下(歩行速度遅延)、骨粗鬆症(円背)、筋力低下と骨粗鬆症および転倒不安(杖の使用)、多病(5種類以上の服薬)であった。これらに含まれない転倒危険因子は過去の転倒歴に含有されていると考える。

重要な点は、地域住民においては、環境要因よりも内的因子である虚弱、多病が転倒に重要であるという知見である。転倒リスクになる薬剤をいかに減らすかは、「安全な医療」の観点から、医師にとって今後重要な課題となろう。

おわりに

転倒予防事業で、今後の転倒危険者を抽出する検査を考える場合、従来のように、環境要因

の問診表と下肢筋力検査（歩行速度、片足立ち時間）などに時間を費やすより、過去の転倒回数を十分聴取し、身体的側面（骨粗鬆症、筋力低下）の情報を得るため、「転倒スコア」を活用することが簡易で、有用であることが示唆された。

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A Cross-Sectional Study of Frailty Status Among the Elderly in a Japanese City

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Abstract

In order to formulate the prevention program under the Long Term Care Insurance (LTCI) scheme, the authors conducted a cross-sectional study of frailty status among the elderly in a Japanese city. The population studied was inhabitants of one city, Fukuoka prefecture. The 3000 inhabitants more than 65 years old were randomly selected from citizen registration by the city council. From June to September 2002, the trained interviewers visited to chosen inhabitants and gathered information using a structured questionnaire composing of demographic data (sex, age, address, household's type), health status, ADL, and IADL. The present study has clarified that most of the aged live independently, even though they have some level of chronic health problems, such as knee-joint disorder and hypertension. Furthermore, even if they have got some problems for their transfer ability, most of them stay independent for other ADL and IADL, such as eating, toileting, bathing and house affairs. There was an interesting difference between male and female for house affaire autonomy. For female, 90% of persons categorized "mobility level 5" were independent for house affaires. On the contrary, only 40% of same mobility level of male were independent for house affaires. This finding indicates the necessity of another important preventive program especially for male.

Key words: frailty, prevention, long term care insurance, ADL, IADL, Japan

❖ Introduction

The very rapid graying of society is on going in Japan. It is estimated that the percentage of population over 65 years old will be over 30% in 2025. Besides this very rapid ageing, the number of births has been decreasing, and in 2003 the Total Fertility Rate (TFR) has become 1.29¹⁾. Along with the economic development after the Second World War, the Japanese disease structure has dramatically changed from the acute diseases dominant pattern (i.e., infectious diseases) to the chronic diseases dominant one (i.e., can-

cer and cardio-vascular diseases).

This demographic change means the increase in dispend and the decrease in tax payers, which requires the Japanese government to re-organize the social security system.

With fewer children, more women working, and changing attitude toward family responsibilities, the traditional system of informal care-giving is widely perceived as inadequate to take care of the increasing number of the frail elderly. In fact, about 40% of the households with elderly people are now so called "aged households", that is, single old person's household or old couple's household. This situation naturally requires the socialization of care, and finally in 2000, the Japanese government implemented the Long Term Care Insurance (LTCI) as a new scheme for the frail elderly²⁾.

The health care reform debate often focuses largely on questions associated with the supply of ser-

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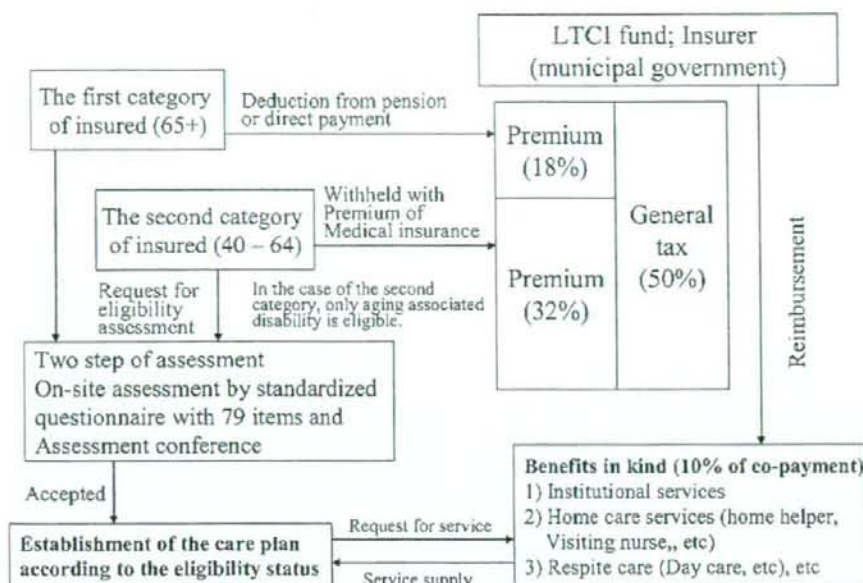


Figure 1. System of Long Term Care Insurance in Japan

VICES, such as measures to organize, finance and deliver health care in the cost-effective way. Less attention has been paid to key aspects of the demand side, in particular how the need for medical and social services might be reduced by improving the health of population. In most of the countries, public health services have been kept quite separate from the curative sector, although it is widely recognized that the two sectors must work together for better health of population.

In order to make the social insurance scheme sustainable in the coming aged society, it is pivotal how to integrate preventive and health promotive activities into the health care system. In this perspective, the authors have investigated the health and ADL level of the aged living in one local government of Fukuoka prefecture, Japan.

❖ Long Term Care Insurance²⁾

Figure 1 describes the LTCI scheme (Modified in 2006). The budget of the insurance is based on fifty percent from the general tax and another fifty percent from the premium of the insured. There are two types of insured; the first category of insured who is 65+, and the second category of insured that is between the age of 40 and 64. The first category of insured is asked to pay a

premium deducted from pension or direct payment for insurer according to their pension status. In the case of the second category of insured, his or her premium is withheld from the medical insurance premium.

The benefit includes social welfare services such as home help and bathing service, stay in nursing home, as well as the use of medical services such as visiting nurses and institutional care in long term care hospitals.

The eligibility process begins with the individual or his/her family applying to the insurer (usually municipal government). A two-step assessment process follows and determines the limit of benefit. The first step is on-site assessment using the 79 items of a standardised questionnaire, each with a choice of three or four levels, plus space for comments on any particular aspects to be remarked on. The 79 items are analysed by an official computer program to classify the applicant into one of 6 levels of dependency or to reject eligibility¹. The lightest level is "assistance required" which is subject to preventive services; the other five levels are called "care required". The second step is the assessment conference by health care professionals. The conference reviews the classification made by a computer program by taking into account the descriptive statement plus a report from

the applicant's home doctor.

Each eligibility level entitles the applicant to an explicitly defined monetary amount of services. The recipient has to pay 10% of the cost as co-payment. Theoretically, users are free to choose services, but in reality, the care-manager who constitutes a care plan, a weekly time schedule of services, intervenes in this process and co-ordinates the services for the applicant.

❖ Studied Population and Method

Studied population

The population studied was inhabitants of one city, Fukuoka prefecture. The 3000 inhabitants more than 65 years old were randomly selected from citizen registration by the city council.

Method

The trained interviewers visited to chosen inhabitants and gathered information using a structured questionnaire from June to September 2002. There was no case of refusal. The questionnaire composes of items regarding demographic data (sex, age, address, household's type), health status, ADL, and IADL. The name of studied people was excluded from the data for analysis in order to assure the privacy.

For evaluation of ADL and IADL, the Typology of Aged with Illustration (TAI) was used^{3,4}.

The statistical analyses were conducted by SPSS.

❖ Results

Basic statistics

Age distribution: 1034 persons (34.5%) were under 70 years old, 1392 persons (46.4%) were between 70 and 79, 510 persons (17.0%) were between 80 and 89, and 64 peoples (2.1%) were more than 90 years old. The average age was 73.4 years old (72.8 for male, 73.9 for female).

Sex distribution: 1746 were female (58.2%), and 1254 were male (41.8%).

Type of household: 473 persons (15.8%) were categorized into "live alone", 1209 (40.3%) were "aged household", and 1318 (43.9%) were "extended family".

The distribution of eligibility status of LTCI was as follows: Non-applicant (2637 persons; 54.8%), in-

process of eligibility evaluation (8; 0.2%), non-eligible (28; 0.6%), assistance required (77; 1.6%). Care required 1 (58; 1.2%), care required 2 (18; 0.4%), care required 3 (6; 0.1%), care required 4 (8; 0.2%), care required 5 (10; 0.2%), unknown or no answer (151; 3.1%).

Health status

206 persons (6.9%) had past and/or present history of cerebro-vascular diseases. 351 persons (11.7%) had past and/or present history of heart diseases. 561 persons (18.7%) had past and/or present history of osteo-articular diseases.

ADL and IADL level

ADL and IADL were measured by TAI scale. Each item in the TAI has six hierarchical status (5 to 0), representing levels of disability in each domain. Five represents no disability and 0 represents extreme disability. Each status is defined by a threshold and illustrated as shown in the example of mobility level (Figure 2), mental status (Figure 3), eating (Figure 4), and Toileting (Figure 5).

Mobility level: 2325 (77.5%) persons were categorized into "5", 311 (10.4%) were "4", 128 (4.3%) were "3", 13 (0.4%) were "2", 11 (0.4%) were "1" and 212 (7.1%) were "0".

Mental status: 2690 (89.7%) persons were categorized into "5", 75 (2.5%) were "4", 9 (0.3%) were "3", 14 (0.5%) were "2", 3 (0.1%) were "1" and 209 (7.0%) were "0".













Eating independence: 2720 (90.7%) persons were categorized into "5", 53 (1.8%) were "4", 7 (0.2%) were "3", 4 (0.1%) were "2", 0 (0.0%) were "0" and 216 (7.2%) were "0".

Toileting independence: 2656 (88.5%) persons were categorized into "5", 94 (3.1%) were "4", 20 (0.7%) were "3", 15 (0.5%) were "2", 4 (0.1%) were "1" and 211 (7.0%) were "0".

Bathing independency: 2542 (84.7%) persons were categorized into "5", 160 (5.3%) were "4", 49 (1.6%) were "3", 26 (0.9%) were "2", 15 (0.5%) were "1" and 208 (6.9%) were "0".

Independency of house affairs: 1733 (57.8%) persons were categorized into "5", 201 (6.7%) were "4", 361 (12.0%) were "3", 57 (1.9%) were "2", 413 (13.8%) were "1" and 235 (7.8%) were "0".

Relationship between mobility level and other ADL items: Table 1 to Table 4 show the relationship

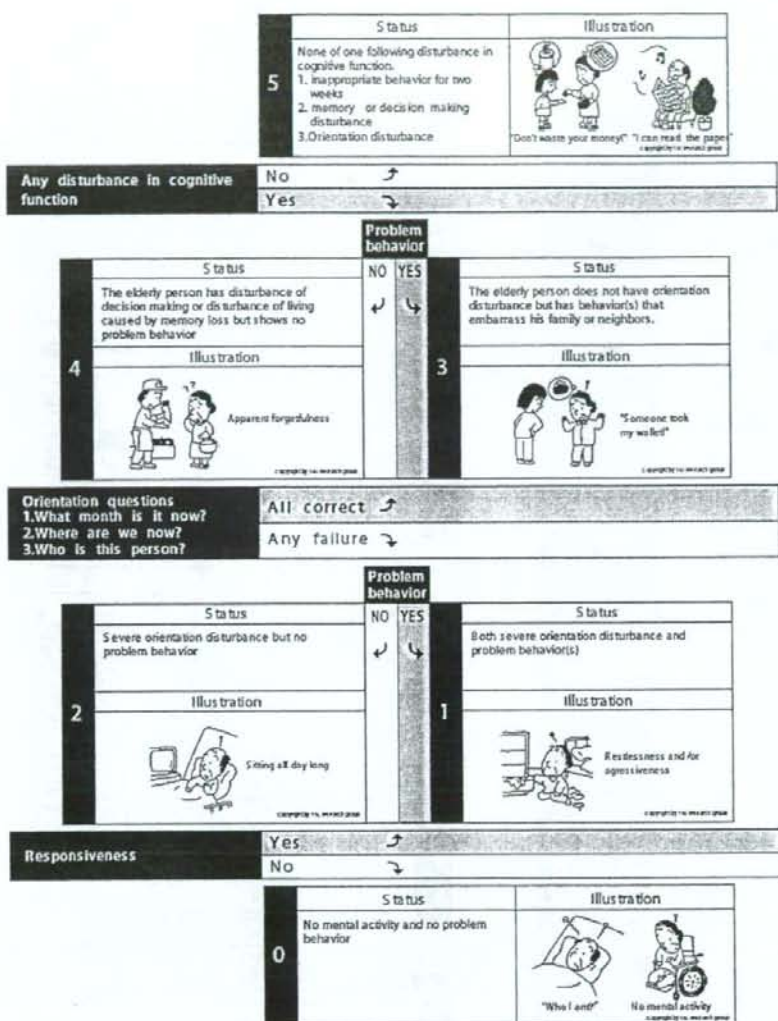
	Level	Status	Illustration
 Climb stairs	5	The elderly person can climb stairs without assistance and can walk out of a house.	
		Yes →	
 Walk alone on a flat floor	4	The elderly person can not climb stairs but can walk alone without assistance on a flat floor.	
		Yes →	
 Both move around using equipment and transfer while sitting	3	The elderly person cannot walk alone on a flat floor without help, but can move on a flat floor with instruments such as walking aid, wheelchair, cane, brace or walk.	
		Yes →	
 Both sit up and maintain seated position	2	The elderly person need help for transferring or moving, but can stand up from bed, and remain seated without help.	
		Yes →	
 Roll over on the bed while lying	1	The elderly person cannot transfer him self while sitting but can remain seated and change body position while lying.	
		Yes →	
	0	The elderly person cannot change body position while lying on a bed.	
		Yes →	

Source: Okochi (2005)

Figure 2. TAI scale for mobility

between mobility level and other ADL items. In the case of eating and mental status, most of the elderly were relatively independent up to mobility level 3. However, the independent level has rapidly decreased from mobility level 4 for bathing and toileting. As the Japanese latrine requires squatting for toileting, and as the Japanese bath tub is usually very deep, the diffi-

culty in mobility will cause considerable difficulty in use of such activities. Another important point is that there is an interesting difference between male and female for house affaire autonomy (Table 5). For female, 90% of persons categorized "mobility level 5" were independent for house affaires. On the contrary, only 40% of same mobility level of male were inde-



Source: Okochi (2005)

Figure 3. TAI scale for mental status

pendent for house affairs.













❖ Discussion

The present study has clarified that most of the aged live independently, even though they have some level of chronic health problems, such as knee-joint disorder and hypertension. Furthermore, even if they have got some problems with their transfer ability,

most of them stay independent for other ADL and IADL, such as eating, toileting, bathing and house affairs.

According to the official statistics, number of persons who received the LTCI services increased from 218.2 thousands in 2000 to 302.5 thousands in 2003, and the largest increase was observed in persons categorized into "care required 1"¹⁵⁾.

The most common disorders among this category













	Level	Status	Illustration
 Stain around the table and/or require prepared food	5	The elderly person can eat cleanly by himself even in a presence of paralysis or dementia and does not require preparation or aid at table.	
		No ↗	
 Require assistance while eating	4	The elderly person can eat by himself regardless of how he eats (without help in preparation). There is no assistance required while eating. However, the elderly person may stain the table.	
		No ↗	
 Swallowing disturbance	3	The elderly person requires assistance while eating. However, there is no swallowing disturbance if the care giver brings foods to the mouth.	
		No ↗	
 Parenteral alimentation	2	The elderly person has swallowing difficulty even if the care giver brings the food to their mouth. Therefore, softened foods such as paste and/or jelly are frequently used.	
		No ↗	
 Intravenous alimentation	1	Parenteral alimentation (nasal, gastric or intestinal)	
		No ↗	
	0	Intravenous alimentation (intravenous, IVH)	
		No ↗	

Source: Okochi (2005)

Figure 4. TAI scale for eating independency level

are osteo-muscler disorders, especially knee-joint problems⁶). According to our previous study, the elderly with knee-joint problems had 2 times more possibility to have other ADL and health problems, such as toileting and mental autonomy⁶). Therefore, it is very important to organize some preventive services for

them. In fact, 60 to 80% of frail elderly evaluated as non-eligible for LTCI scheme have the bone-articular problems. Previous studies have indicated that the prevention of disabilities consequent on non-fatal conditions, such as chronic arthritis, is the most cost-effective preventive strategy^{7, 8}).

	Level	Status	Illustration
 Use toilet cleanly	5	The elderly person goes to toilet by himself and shows no failure of excretion for at least two weeks. There is no portable toilet or other aid at bedside.	
		No →	Yes →
 Require assistance to go to the toilet	4	The elderly person goes to toilet by himself regardless of failure. The elderly person does not use a diaper or portable toilet except for special occasions such as during travel. This category includes the elderly persons with ostoma who controls excretion by himself.	
		No →	Yes →
 Use diaper always	3	The care giver must give instruction or help to the elderly to go to the toilet. The elderly person does not always require diaper.	
		No →	Yes →
 Difficulty changing diaper	2	The elderly person always requires diaper. However, the elderly person cooperates in changing diaper.	
		No →	Yes →
 Catheterization	1	The care giver has difficulty changing the diaper of the elderly person. Therefore, it requires two persons to change the diaper. The elderly person may exhibit polluting of surroundings by urine, problem behaviour with urine, and toileting on the bed.	
		No →	Yes →
	0	The elderly person require catheterization. This category includes the elderly person whose ostoma requires to be treated by care-givers.	
		No →	Yes →

Source: Okochi (2005)

Figure 5. TAI scale for toileting independency level

After the introduction of the LTCI scheme, the two service categories have largely increased their users; home help services and day services. Home helpers assisted the frail elderly for house affairs, especially toileting and bathing, and day service centers offer them cafeteria and bathing services.

Based on the findings of this study, the city office has organized preventive services for the non-eligible elderly. The first-year result of this program was very encouraging. Among 199 persons receiving the preventive services, such as rehabilitation and aid services, only 5 persons had entered into LTCI scheme or

Table 1. Relationship between mobility level and mental status level

Mobility		Mental status						Total
		0	1	2	3	4	5	
0	N	201	1	1		1	5	209
	Mobility (%)	96.2	0.5	0.5		0.5	2.4	100.0
	Mental (%)	97.6	33.3	7.1		1.4	0.2	7.3
1	N	2			3	3	3	11
	Mobility (%)	18.2			27.3	27.3	27.3	100.0
	Mental (%)	1.0			33.3	4.1	0.1	0.4
2	N	1		2		3	6	12
	Mobility (%)	8.3		16.7		25.0	50.0	100.0
	Mental (%)	0.5		14.3		4.1	0.2	0.4
3	N		1	6	1	26	92	126
	Mobility (%)		0.8	4.8	0.8	20.6	73.0	100.0
	Mental (%)		33.3	42.9	11.1	35.1	3.6	4.4
4	N		1	4	3	31	269	308
	Mobility (%)		0.3	1.3	1.0	10.1	87.3	100.0
	Mental (%)		33.3	28.6	33.3	41.9	10.5	10.7
5	N	2		1	2	10	2188	2203
	Mobility (%)	0.1		0.0	0.1	0.5	99.3	100.0
	Mental (%)	1.0		7.1	22.2	13.5	85.4	76.8
Total	N	206	3	14	9	74	2563	2869
	Mobility (%)	7.2	0.1	0.5	0.3	2.6	89.3	100.0
	Mental (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2. Relationship between mobility level and eating level

Mobility		Eating level						Total
		0	1	2	3	4	5	
0	N	200		3	1	3	2	209
	Mobility (%)	95.7		1.4	0.5	1.4	1.0	100.0
	Mental (%)	93.9		75.0	14.3	6.1	0.1	7.3
1	N			1	4	3	3	11
	Mobility (%)			9.1	36.4	27.3	27.3	100.0
	Mental (%)			25.0	57.1	6.1	0.1	0.4
2	N				2	4	6	12
	Mobility (%)				16.7	33.3	50.0	100.0
	Mental (%)				28.6	8.2	0.2	0.4
3	N					21	105	126
	Mobility (%)					16.7	83.3	100.0
	Mental (%)					42.9	4.0	4.4
4	N	1				17	290	308
	Mobility (%)	0.3				5.5	94.2	100.0
	Mental (%)	0.5				34.7	11.2	10.7
5	N	12				1	2190	2203
	Mobility (%)	0.5				0.0	99.4	100.0
	Mental (%)	5.6				2.0	84.4	76.8
Total	N	213		4	7	49	2596	2869
	Mobility (%)	7.4		0.1	0.2	1.7	90.5	100.0
	Mental (%)	100.0		100.0	100.0	100.0	100.0	100.0

Table 3. Relationship between mobility level and toileting independency level

Mobility		Toileting independency level						Total
		0	1	2	3	4	5	
0	N	201	2	4			2	209
	Mobility (%)	96.2	1.0	1.9			1.0	100.0
	Mental (%)	96.6	50.0	26.7			0.1	7.3
1	N		1	7		2	1	11
	Mobility (%)		9.1	63.6		18.2	9.1	100.0
	Mental (%)		25.0	46.7		2.2	0.0	0.4
2	N			3	5	3	1	12
	Mobility (%)			25.0	41.7	25.0	8.3	100.0
	Mental (%)			20.0	26.3	3.3	0.0	0.4
3	N			1	7	53	65	126
	Mobility (%)			0.8	5.6	42.1	51.6	100.0
	Mental (%)			6.7	36.8	57.6	2.6	4.4
4	N	1	1		5	27	274	308
	Mobility (%)	0.3	0.3		1.6	8.8	89.0	100.0
	Mental (%)	0.5	25.0		26.3	29.3	10.8	10.7
5	N	6			2	7	2188	2203
	Mobility (%)	0.3			0.1	0.3	99.3	100.0
	Mental (%)	2.9			10.5	7.6	86.4	76.8
Total	N	208	4	15	19	92	2531	2869
	Mobility (%)	7.2	0.1	0.5	0.7	3.2	88.2	100.0
	Mental (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4. Relationship between mobility level and bathing independency level

Mobility		Bathing independency level						Total
		0	1	2	3	4	5	
0	N	200	6	1			2	209
	Mobility (%)	95.7	2.9	0.5			1.0	100.0
	Mental (%)	97.6	42.9	4.0			0.1	7.3
1	N		6	5				11
	Mobility (%)		54.5	45.5				100.0
	Mental (%)		42.9	20.0				0.4
2	N			5	3	3	1	12
	Mobility (%)			41.7	25.0	25.0	8.3	100.0
	Mental (%)			20.0	6.1	1.9	0.0	0.4
3	N	1		14	36	59	16	126
	Mobility (%)	0.8		11.1	28.6	46.8	12.7	100.0
	Mental (%)	0.5		56.0	73.5	37.8	0.7	4.4
4	N	2			9	78	219	308
	Mobility (%)	0.6			2.9	25.3	71.1	100.0
	Mental (%)	1.0			18.4	50.0	9.0	10.7
5	N	2	2		1	16	2182	2203
	Mobility (%)	0.1	0.1		0.0	0.7	99.0	100.0
	Mental (%)	1.0	14.3		2.0	10.3	90.2	76.8
Total	N	205	14	25	49	156	2420	2869
	Mobility (%)	7.1	0.5	0.9	1.7	5.4	84.3	100.0
	Mental (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5. Relationship between mobility level and house affaire independency level

Male		House affaire independency level						
Mobility		0	1	2	3	4	5	Total
0	N	69			1			70
	Mobility (%)	98.6			1.4			100.0
	Mental (%)	82.1			0.4			5.9
1	N	1	1				1	3
	Mobility (%)	33.3	33.3				33.3	100.0
	Mental (%)	1.2	0.3				0.3	0.3
2	N		3					3
	Mobility (%)		100.0					100.0
	Mental (%)		0.9					0.3
3	N	5	32	4	8	1		50
	Mobility (%)	10.0	64.0	8.0	16.0	2.0		100.0
	Mental (%)	6.0	9.6	14.3	3.1	1.2		4.2
4	N	3	36	6	23	14	8	90
	Mobility (%)	3.3	40.0	6.7	25.6	15.6	8.9	100.0
	Mental (%)	3.6	10.8	21.4	9.0	16.3	2.0	7.6
5	N	6	262	18	224	71	390	971
	Mobility (%)	0.6	27.0	1.9	23.1	7.3	40.2	100.0
	Mental (%)	7.1	78.4	64.3	87.5	82.6	97.7	81.8
Total	N	84	334	28	256	86	399	1187
	Mobility (%)	7.1	28.1	2.4	21.6	7.2	33.6	100.0
	Mental (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Female		House affaire independency level						
Mobility		0	1	2	3	4	5	Total
0	N	137	1				1	139
	Mobility (%)	98.6	0.7				0.7	100.0
	Mental (%)	93.2	1.6				0.1	8.3
1	N	4	4					8
	Mobility (%)	50.0	50.0					100.0
	Mental (%)	2.7	6.6					0.5
2	N	1	5	2	1			9
	Mobility (%)	11.1	55.6	22.2	11.1			100.0
	Mental (%)	0.7	8.2	7.4	1.1			0.5
3	N	2	20	15	18	13	8	76
	Mobility (%)	2.6	26.3	19.7	23.7	17.1	10.5	100.0
	Mental (%)	1.4	32.8	55.6	20.2	12.3	0.6	4.5
4	N		13	8	36	74	87	218
	Mobility (%)		6.0	3.7	16.5	33.9	39.9	100.0
	Mental (%)		21.3	29.6	40.4	69.8	6.9	13.0
5	N	3	18	2	34	19	1156	1232
	Mobility (%)	0.2	1.5	0.2	2.8	1.5	93.8	100.0
	Mental (%)	2.0	29.5	7.4	38.2	17.9	92.3	73.2
Total	N	147	61	27	89	106	1252	1682
	Mobility (%)	8.7	3.6	1.6	5.3	6.3	74.4	100.0
	Mental (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0

hospitalized⁶). The city office estimated its financial effect as about 40 million yen (400 thousand US \$) of cost containment per year. Encouraged by these results, the city office enlarged this program from 2003 in order to rationalize the expenditure for the LTCI services. According to these encouraging results, the Ministry of Health, Labor and Welfare has decided to enforce preventive activities under the LTCI scheme. Some new preventive services are planned to be included into the LTCI scheme from 2006.

In order to ameliorate the autonomy level of the elderly people, the current study has revealed an interesting finding about house affairs autonomy level. As indicated in Table 5, there was an interesting difference between male and female for house affairs autonomy. For female, 90% of persons categorized "mobility level 5" were independent for house affairs. On the contrary, only 40% of same mobility level of male were independent for house affairs. This finding indicates the necessity of another important preventive program especially for male. The above fact suggests that the male elderly has a higher possibility to use home help services compared with the female elderly, if they become slightly frail. The city office is planning to organize community education classes for the male adults where they can learn how to manage house affairs, such as cooking and cleaning.

The present study is a cross-sectional study, thus it is not appropriate to derive a definitive conclusion from the current findings. We are following this population from 2002 consecutively. We would like to present further findings from the on-going cohort study in the future literatures.

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❖ Note

- ¹ By the modification of LTCI law in 2006, "care required 1" was divided into "assistance required 2" and "care required 1", and "assistance required" was renamed "assistance required 1".

Healthy Housing as an Infrastructure of Health Support System

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Abstract

In order to evaluate the importance of housing program for the healthy aged society, we have conducted a situation analysis of housing condition of the aged living in a city of Fukuoka Prefecture. The data was collected from 2,611 elderly people living in a city of Fukuoka prefecture. At first, the necessity of reconstruction was cross-evaluated by sex, age, type of household, health status, ADL independency level, type of residence. Then factors associated with willingness to use the institutional care were analyzed by the logistic regression analysis. The present results clarified that the aged living in the houses with necessity of reconstruction have showed more willingness to use institutional services that are covered by the public medical insurance and LTCI. Historically, the housing policy has long been separated from the public health policy in Japan. It is strongly recommended to integrate the housing policy into the public health policy in order to realize a healthy aged society.

Key words: Healthy housing, home care, institutional care, the aged, Japan

❖ Introduction

The very rapid ageing is on going in Japan. Table 1 shows the chronological changes of demographic structure¹⁾. It is estimated that there will be 1.7 million deaths in 2038²⁾. In 2003, 78.3% of deaths occurred at hospital and 13.0% were at home³⁾. Apparently, it will become impossible to deliver enough volume of terminal care only at hospital. Faced with the rapid ageing of society, it becomes an urgent task to prepare a well organized home care system in Japan.

In order to promote home care, the Japanese government introduced the Long Term Care Insurance (LTCI) in 2000. In 2000, 600,000 aged were institutionalized, and 1,240,000 aged received home-based ADL care services on monthly basis⁴⁾. On monetary base, these figures correspond to 194.0 billion yen

(1.94 billion USD; 100 yen = 1 USD) to institutional care and 99.6 billion yen (1.00 billion USD) to home-based care in each month. Six years later, in 2006, the monthly average number of aged persons who received institutional care and home-based care increased up to 810,000 and 2,570,000, respectively. On monetary base, these figures correspond to 206.3 billion yen (2.06 billion USD; 100 yen = 1 USD) for institutional care and 228.9 billion yen (2.29 billion USD) for home-based care. Even though the home care has been much advanced, the government considers there is still a room for promotion of home care.

In the 2006 Health Care Reform Plan, the government clarified its will to further promote the home care. The Ministry of Health, Labour and Welfare (MHLW) has largely decreased the tariff for long-term care beds intending to decrease a large number of this type of beds within the coming 5 years. Decreased beds are recommended to be transformed to a new type of residence for the aged; such as assisted living and nursing home. These types of facilities do not require higher staffing, thus do cost less both for delivery side and insurers. In order to facilitate this reorganization

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Table 1 Chronological changes in the age structures

	Total	Age category		
		0-14	15-64	65-
1950	84,114,574 100.0%	29,786,412 35.4%	50,168,312 59.6%	4,155,180 4.9%
1960	94,301,623 100.0%	28,434,159 30.2%	60,469,355 64.1%	5,397,980 5.7%
1970	104,665,171 100.0%	25,152,779 24.0%	72,119,100 68.9%	7,393,292 7.1%
1980	117,060,396 100.0%	27,507,078 23.5%	78,834,599 67.3%	10,647,356 9.1%
1990	123,611,167 100.0%	22,486,239 18.2%	85,903,976 69.5%	14,894,595 12.0%
2000	126,925,843 100.0%	18,472,499 14.6%	86,219,631 67.9%	22,005,152 17.3%
2005	127,767,994 100.0%	17,521,234 13.7%	84,092,414 65.8%	25,672,005 20.1%

of service delivery system, the government prepares a special loan with very low interest rate for them.

But it will be rather difficult to succeed unless they prepare supportive environment for the promotion of home care of the frail elderly. As our previous results indicated⁵⁾, a considerable number of frail elderly prefer to stay at hospitals because they regard the hospital as a safety and comfortable residence. This finding suggests that it must be required to prepare the safe and healthy housing for the aged in order to promote home care.

In order to evaluate the importance of housing program for the healthy aged society, we have conducted a situation analysis of housing condition of the aged living in a city of Fukuoka Prefecture.

❖ Studied Population and Method

Studied population

The population studied was inhabitants of a city of Fukuoka prefecture. The 2,677 inhabitants more than 65 years old were randomly selected from citizen registration by the city council. Among them we have used data of 2611 peoples with sufficient information about residence for the analysis. There are no significant differences between the included and excluded persons for the distribution of age, sex, ADL dependency level.

Method

The trained interviewers visited to chosen inhabitants and gathered information using a structured questionnaire from June to September 2003. The questionnaire composes of items regarding demographic data (sex, age, address, household's type), health status, ADL and IADL, type of residence (apartment house or detached, private or public), necessity of reconstruction of residence, and willingness to use institutional services covered by medical insurance or LTCI (long-term care wards, medical nursing home, and nursing home). The name of studied people was excluded from the data by the city office in order to assure the privacy.

At first the necessity of reconstruction was cross-evaluated by sex, age, type of household, health status, ADL independency level, type of residence. Then factors associated with willingness to use the institutional care were analyzed by the logistic regression analysis.

For evaluation of ADL and IADL, the TAI (Typology of Aged with Illustration) was used⁶⁾.

The statistical analyses were conducted by SPSS 15.0J.

❖ Results

Table 2 shows the general characteristics of stud-