

はかつては存在しなかった、または重視されてこなかった、緩和医療、リハビリテーション、障害医療、老年医療、在宅医療、終末期医療の重要度が高まってきている。

超高齢社会における栄養の問題

戦後の食糧不足事態を脱却し、高度成長時代より、日本の栄養に関する医療上の問題は過栄養であった。図1に各年代の疾病、ならびに医療上の問題点を並べた。もちろん、現在もこの過栄養問題は継続しており、成人時

代に大問題となる糖尿病をはじめとする生活習慣病、メタボリックシンドロームは全てこの過栄養と関連している。一方で上記のようにこの国は人口構造の変化が起こっており、高齢者、特に後期高齢者が急増している問題がある。栄養の問題は大きく年齢に依存し、後期高齢者では真逆の低栄養の問題が出てくる。

図2は典型的な老年期に起こってくる栄養の問題を記載した。前期高齢者は総じて元気で、活動的である。しかし、この時期より

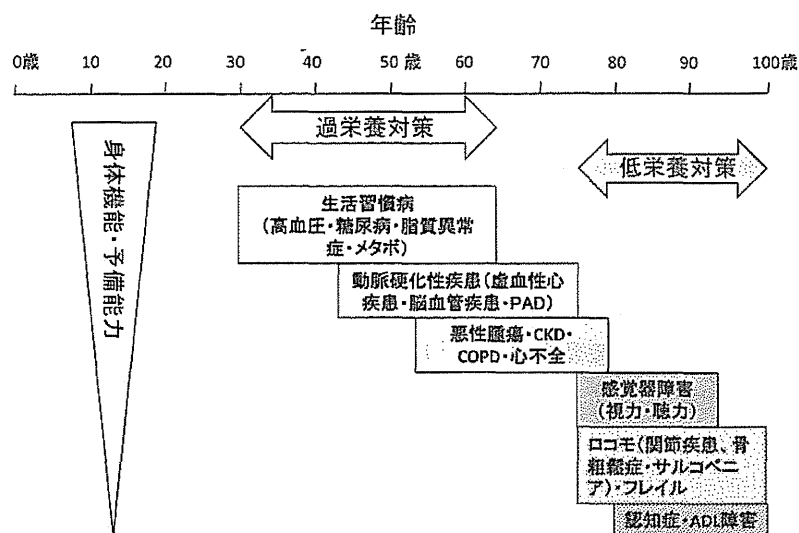


図1. ライフステージと健康寿命に関連する主要な健康問題

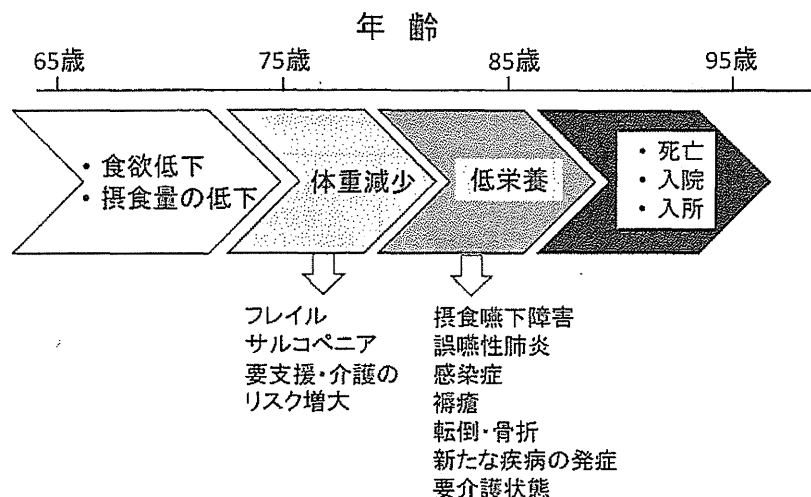


図2. 加齢と栄養関連事項の時間経過

徐々に食欲は低下し、摂取量自体も低下しがちとなる。さらに75歳以上の後期高齢者になると前期高齢者の摂取量低下が体に徐々に影響を現し、体重減少を認めるようになる。この時期には体重減少と関連が強い、骨格筋量低下さらには筋力低下も現れ（サルコペニア）、虚弱（フレイル）状態に陥りやすく¹⁾、介護予防の対象者となりやすい。それがさらに進行すると、まさしく低栄養状態に陥り、この時には摂食嚥下障害を併発しやすくなり、誤嚥性肺炎や、低栄養による免疫力の低下によりさまざまな感染症を併発しやすく、さらには上記のサルコペニアの影響で転倒・骨折につながりやすい。これらは全て要介護状態、入院、さらには生命予後に直結する²⁾。低栄養が全てこれらの原因になっているとは限らず、逆に結果となっているケースも多い。

高齢者の摂食嚥下障害

我々の病棟（老年内科）は8割が救急車で来院し、入院となる高齢者救急の病棟である。その入院患者の頻度の多い三大障害は日常生活動作障害（activity daily living：ADL障

害）、認知機能障害、そして摂食嚥下障害である。最後の摂食嚥下障害は、咀嚼障害、嚥下障害の存在により十分な栄養が経口から入らない状況である。これらの障害があることにより、十分な栄養が摂取できず急性疾患が治癒できたとしても家に帰れないケースが大変多い。経管栄養（胃瘻を含む）や静脈栄養に移行せざるを得ないケースもまれではない。

以前厚生労働省班研究で分担研究者により全国の特別養護老人ホーム、老人保健施設、医療療養病床において経管栄養、摂食嚥下障害を抱える入所、入院高齢者の割合について調査が実施された。結果を図3に示すが、特に施設ならびに慢性期病床で経管栄養ならびに口で食べていたとしても誤嚥を伴う対象者の割合が大変多い結果であった。

また、別の厚生労働省班研究で在宅療養中の高齢者を対象に嚥下障害の有無、栄養障害の有無を調査したが、図4のごとく、要介護度が高くなるにつれ摂食嚥下障害の割合が高くなり（図4A）、さらに摂食嚥下障害の存在と栄養障害との間に強い関連を認めた（図4B）。すなわち、摂食嚥下障害の重症度が

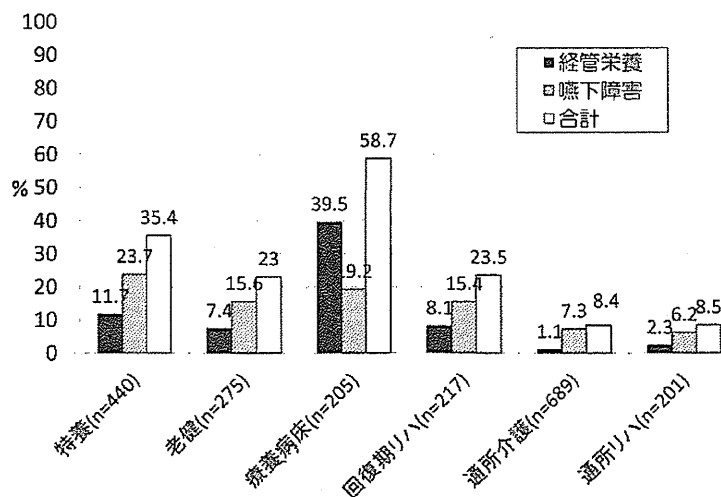


図3. 高齢者の嚥下困難・経口摂取困難の頻度

厚生労働科学研究費補助金（長寿科学総合研究事業）H21～23年「高齢者の経口摂取の維持ならびに栄養ケア・マネジメントの活用に関する研究（班長：葛谷雅文、分担：杉山みち子、榎裕美ら）」報告書より

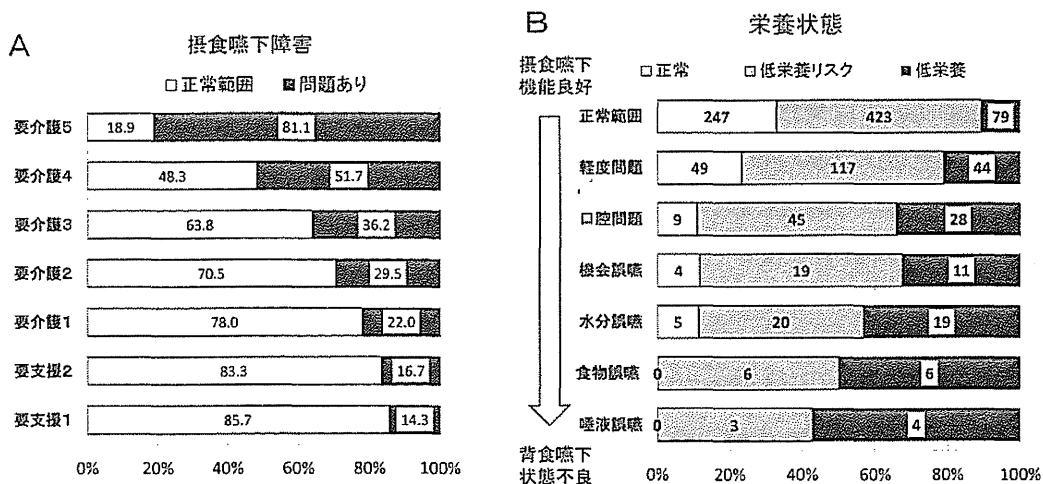


図4. 要介護度と要介護度と摂食嚥下障害との関係ならびに摂食嚥下状態と栄養状態との関係

摂食嚥下障害は摂食・嚥下障害臨床的重症度分類 (Dysphagia severity scale) を使用し、「問題あり」はレベル1～4とした。栄養状態の評価はmini-nutritional assessment-short form を使用した。厚生労働科学研究費補助金 (長寿科学総合研究事業)「地域・在宅高齢者における摂食嚥下・栄養障害に関する研究-特にそれが及ぼす在宅療養の非継続性と地域における介入・システム構築に向けて」平成24～26年 班長：葛谷雅文、分担研究者：杉山みち子、榎裕美ら。

増すと、低栄養の有症率が増加した。

また、以前在宅療養中の高齢者は何を食べているか、普通食、介護食 (粥食、刻み食、ミキサー食等)、経管栄養と分けて、3年間の全入院、死亡、肺炎による入院、死亡との関連を検討した³⁾。結果は普通食、介護食、経管栄養の順に全死亡、入院、さらには肺炎による死亡、肺炎による入院が起こりやすくなっていることが明らかであった。従って、口から食事を食べる能力が健康維持に大変重要であることがわかる。

不適切な食事提供

病院、施設では管理栄養士などが配置され、おそらく対象患者、入所者の摂食嚥下能力に合わせた食事が提供されていると思う (思いたい)。しかし、残念ながら地域、在宅では、まずは摂食嚥下能力の評価が十分施されておらず、またその能力にあった食事提供がされているかどうか不明である。今後地域包括ケアシステムの推進に当たって、この食べる

能力、栄養に関する部分が大変脆弱であるのが心配である。おそらく、地域で療養を続けている高齢者の中には摂食嚥下能力に見合わない食事の提供を受けている対象者が相当数おられるのではないであろうか。それが誤嚥性肺炎や、窒息の原因となったり、さらには不適切な食形態のために十分な摂取がかなわず、栄養障害に陥っている対象者が相当数、存在するのではないであろうか。

介護食ならびにスマイルケア食

介護食とは一般に咀嚼や嚥下機能に問題がある対象者のために、食物を摂取しやすく調整した食事を指す。具体的には流動食、刻み食、ペースト食、ミキサー食、ソフト食、ゼリー食、とろみ食、粥食、など色々な種類、呼称が存在している。しかも、刻み食でもどれほどの大きさの刻みなのか、どれほどの硬さのソフト食なのか、など無数のバリエーションが存在している。

農林水産省では平成25年2月より、介護関

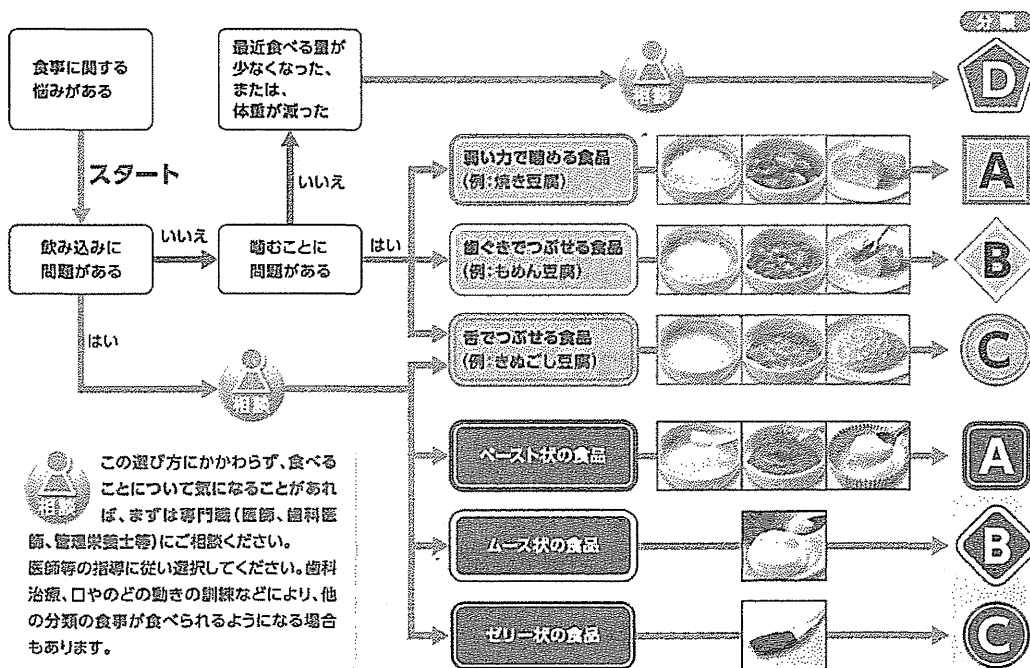
係者や学識経験者等による「これからの介護食品をめぐる論点整理の会」を立ち上げ、そこで論点整理をし、さらにその論点に沿って「介護食品のあり方に関する検討会議」が行われ、様々な問題の整理、提言を行ってきた。根本的な問題として「介護食」の定義が明確でないという問題が挙がってきた。まずは定義を明確化し、さらに介護食を「スマイルケア食」とネーミングし親しみやすいものにするのと、そのスマイルケア食の中の様々な食品の選択をアルゴリズムを使用して、購入する際に判りやすいものにした(図5)。また、今回介護食の対象者を少し範囲を広げ、噛む、飲み込むなどの食べ方の問題がある対象者だけではなく、低栄養状態にある、または今後低栄養状態に至る危険性がある対象者を含む提言がなされた。

今後この介護食、スマイルケア食の使用が望まれる対象者は増加することが予測され、今回の農林水産省の取り組みは、国民、さらには食にかかわる事業者にも食の重要性を再

認識させる意味でも大きな役割を果たしたものと思われる。すなわち、単に食品製造業者がスマイルケア食を開発し、普及させるという問題だけではなく、配食サービス事業者や会食サービス事業者を含む食事支援者への有機的な取り組みをさらに促進し、国民に対して食への関心、栄養に対する関心を高める効果も期待される。実際、この食に関連する問題は、後期高齢者がさらに増加するわが国にとっては、ますます注目していかなければならない分野である。

地域包括ケアシステムにおけるスマイルケア食の位置づけ

今後、後期高齢者の急増が見込まれることもあり、持続可能な医療を構築するために現在地域包括ケアシステムの構築が全国で進んでいる。この介護食が必要となるような地域で様々な医療・介護サービスを使用しながら療養している高齢者(高齢者だけではないが)はまさしくこの地域包括ケアシステムの



詳しくは農林水産省ホームページ <http://www.maff.go.jp/j/shokusan/seizo/kaigo/jyohou.html>へ

図5. 新しい介護食品 (スマイルケア食) の選び方

中心に位置することとなる。今後この地域包括ケアシステムの中に如何にこの食、栄養、摂食嚥下機能といったキーワードを入れていくかは大変重要であると思う。それには医療者、介護関係者、さらには国民全体にこの食の問題、栄養の問題に関心を持っていただくことがまずは大切である。

農林水産省のスマイルケア食の提言は今後これらをどのように提供するのか、どのように適切に使用者の能力にあったものを提供するかの問題は残るが、一歩前に前進したことには間違いはない。提供に関しての問題は大きく分けて二つあると思われる。

一つは提供する対象者、すなわち、このスマイルケア食が必要な対象者を把握する、拾い上げるシステムの構築が必要である点である。これには家族、介護者、医療者、介護職に対しての栄養、食、摂食機能に関する啓蒙、教育が必要である。第二に適切な摂食嚥下機能に見合った食を提供する問題である。地域包括ケアシステムの中で、この評価システムをどのように構築するかが重要である。地域の医療機関で評価システムを構築する、製品を提供するドラッグストアなどで簡易な評価が実施できるようにする、などもあるかもしれない。

食費のことを考えると3食ともスマイルケア食を購入して、ということは中々難しい。したがって、これに相当する食事をどのように調理するかなどの指導も地域では必要になる。スマイルケア食を規範として、在宅でそ

れ相当の適切な介護食を介護者が料理する方策も必要である。

世界を見据えて

先ほども述べたが、日本は長寿社会のフロントランナーであり、われわれの後には欧米諸国、さらにはアジア諸国が続く。聞くところによると、日本ほどこのような多種類の介護食が手に入る国は無いようで、今後日本のスマイルケア食が外国にも注目される時期がそう遠くない時期に来るかもしれない。

さいごに

今回の農林水産省の介護食（「スマイルケア食」）に関する取り組みが、国民、さらには食に関するプロフェッショナル、医療者、介護関係者に食事、栄養、食べる能力の重要性を再認識させ、今後それぞれに何らかの問題を抱える対象者に適切な食事が提供され、低栄養、健康障害を予防し、健康長寿社会の構築につながることを切に願うものである。

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Effects of leisure activities at home on perceived care burden and the endocrine system of caregivers of dementia patients: a randomized controlled study

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ABSTRACT

Background: Psychological stress associated with caregiving is thought to underlie the high incidence of hypertension, ischemic heart disease, and mortality, as well as reduced immune function, among caregivers of dementia patients. Here, we examined the effects of periodic leisure activities performed by caregivers of dementia patients with care recipients at home on perceived care burden and levels of stress hormones.

Methods: Participants were 42 caregivers aged ≥ 65 years of patients diagnosed with Alzheimer's dementia. They were randomly assigned to intervention and non-intervention groups. The intervention group underwent a leisure activity program (30 min/3 times/week for 24 weeks) with the care recipient, and the control group underwent normal care activities.

Results: The Zarit Burden Interview (ZBI) score, a subjective indicator of care burden, significantly decreased after intervention in the intervention group ($p < 0.05$), whereas no difference was observed in the control group. No significant changes were observed in adrenaline, noradrenaline, dopamine, and cortisol levels in both groups.

Conclusions: The lack of changes in stress hormone levels despite a decrease in subjective care burden in the intervention group might be explained by the effects of the chosen leisure activity on the neuroendocrine system. Our findings suggest that periodic leisure activities can reduce perceived care burden among caregivers of dementia patients. However, in order to evaluate accurately the effects of leisure activities of the present study, long-term follow-up of both caregivers and care recipients is necessary. The Nagoya University Department of Medicine Ethics Committee Clinical Trials Registry Number is 1290.

Key words: dementia, care burden, regular leisure activity, intervention, catecholamine

Introduction

Compared to caregivers of patients with other diseases, caregivers of dementia patients (hereafter, "caregivers") experience a greater psychological burden that corresponds to the severity of the care recipients' condition (Onishi *et al.*, 2005; Muraki *et al.*, 2008). Caregivers are also prone to hypertension (Shaw *et al.*, 1999) and ischemic heart disease (Mausbach *et al.*, 2007) and have high

mortality rates (Schulz and Beach, 1999). While various factors may contribute to the high incidence of vascular lesions, one potential underlying mechanism is the higher blood coagulability of caregivers compared to non-caregivers (Von Kanel *et al.*, 2005), which might be attributed to the psychological stress associated with caregiving.

We previously reported that the degree of perceived care burden among elderly caregivers is related to the extent of reduced physical activity, in particular, leisure activities other than sports (Hirano *et al.*, 2011a). Leisure activities have the advantages of entertainment, rest, and self-development (Suzuki, 2004), and reportedly increase the quality of life (Daniel and Manigandan, 2005).

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Japan's population is rapidly aging, and by 2015, an estimated 25% of Japan's total population will be elderly. Nuclearization of families carries with it the social challenge of increased perceived care burden among elderly caregivers within the family. In Sweden, "housing, work, and leisure" are considered basic rights of living. In other words, leisure is considered a right. Yet, previous studies have suggested that elderly caregivers lack sufficient time to rest and have little time to spare (e.g. for leisure activities), given the large amount of time spent on caregiving. As a result, they have difficulty securing opportunities for periodic leisure activities.

Many interventional studies aimed at reducing perceived care burden have focused on counseling and education, and in one study, satisfaction with leisure improved after intervention (Burgio, 2003). In studies of leisure that targeted caregivers, activities involving going out, such as dancing, eating at restaurants, and going to concerts, improved physical symptoms and depression and increased happiness when both caregivers and care recipients participated in the activities together (Wilz and Fink-Heitz, 2008).

In many cases, elderly caregivers often suffer from physical disorders which limit their ability to exercise, or are limited by movement disorders. Moreover, some caregivers have difficulty performing exercises at the same slow pace as their care recipients. Thus, there is clearly a need to develop a program that increases the amount of leisure activities for caregivers at home, in order to reduce the perceived care burden over a broader population base. To this end, we examined whether caregivers performing leisure activities at home together with care recipients improves caregiver health and reduces perceived care burden. We hypothesized that periodic leisure activities would reduce perceived care burden and improve biochemical parameters related to hypertension and ischemic heart disease.

The development of a program that reduces perceived care burden among at-home caregivers who have difficulties going out due to care obligations, or for caregivers limited by chronic illnesses, would immeasurably contribute to society. Such a program would not only reduce perceived care burden through leisure activities, but would also maintain and improve caregiver health and prevent vascular diseases by improving the balance of the sympathetic and parasympathetic nervous systems.

Materials and methods

Participants

Participants were 54 caregivers living with patients aged 65–80 years who fit the DSM-IV criteria for

Alzheimer's dementia (APA, 1994), as diagnosed by geriatric physicians. Although we targeted healthy caregivers, we also included those with satisfactory control of their chronic diseases (e.g. hypertension, diabetes, and dyslipidemia) through periodic treatment at medical facilities. Those with a history of cerebrovascular or heart disease, such as stroke and myocardial infarction, or liver disease were excluded. Moreover, caregivers who performed leisure activities for more than three months before enrolling in the study were excluded, as were those who had been habitually performing leisure activities once or more a week (Figure 1).

Study design

Participants were randomly assigned to one of two groups, i.e. the intervention or non-intervention group, in sequential order before investigating baseline characteristics. The intervention group performed a leisure activity program three times a week (30 min each) for 24 weeks together with care recipients, and the non-intervention group underwent normal care activities. We assessed changes in the primary and secondary outcome measures discussed below before intervention, and six months after intervention, to determine whether leisure activities reduce perceived care burden.

Assessed factors and scales

The primary outcome measure was caregiver burden as measured by the ZBI (Zarit *et al.*, 1980). We used the 22-item Japanese version of the ZBI questionnaire. The questionnaire converts physical burden, psychological burden, and economical difficulties associated with caring for individuals with care needs at home into a care burden score.

Secondary outcome measures included plasma levels of three fractions of catecholamines (adrenaline, noradrenaline, and dopamine), cortisol, aldosterone, and renin. Renin and aldosterone, hormones with vasopressor activity which are easily influenced by stress, are involved in the modulation of electrolyte levels and the volume of bodily fluids, and increase blood pressure upon stimulation of sympathetic nerves. The higher these values, the more likely increases in circulating blood volume leads to hypertension.

Cortisol is involved in sugar, protein, and fat metabolism, has anti-inflammatory and immunosuppressive effects, and its levels are influenced by stress. High cortisol levels are associated with increased blood sugar, accelerated anabolism (i.e. generation of proteins), accelerated fat metabolism

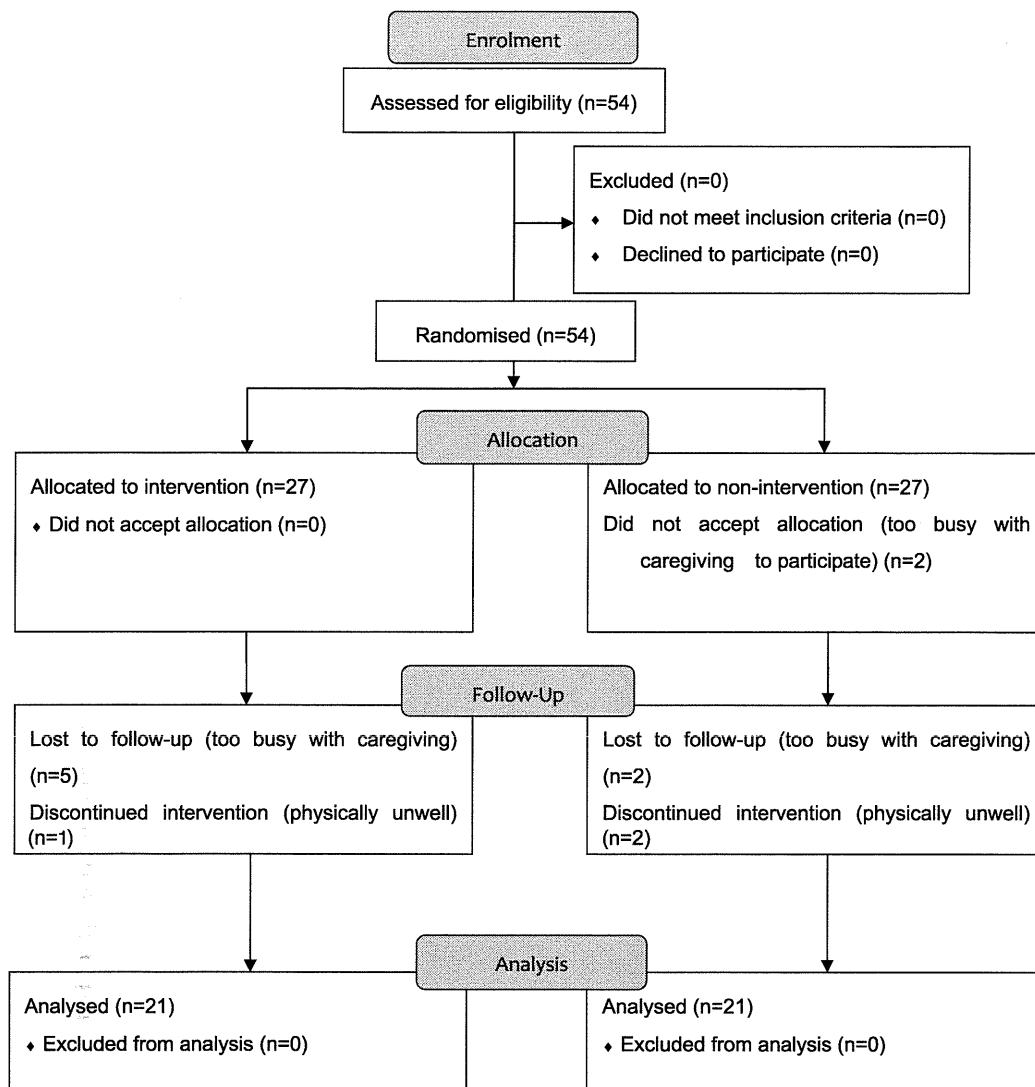


Figure 1. (Colour online) Outline of research process.

(accumulation of fat), anti-inflammatory effects, and immunosuppressive effects (inhibits inflammation and dampens immunity). Adrenaline not only increases blood pressure, but also increases blood sugar levels.

These endocrine hormones, when considered long-term, are factors that influence hypertension and ischemic heart disease. Levels of the endocrine hormones assessed in this study change in response to psychological stress, room temperature, body movements, and diurnal variation. Thus, blood was collected in a room with a fixed temperature in the resting state so as to avoid psychological stress and body movements. To avoid the influence of diurnal variation in plasma cortisol levels, blood was collected each time at approximately the same time of the day.

Calculation of leisure score

A daily living activity survey was conducted to measure total physical activity (Voorrips *et al.*, 1991). Total physical activity consists of scores for housework, sports, and leisure, and higher total scores indicate a higher level of physical activity. For calculating the leisure score, activities other than housework and sports activities (e.g. walking, playing golf, gymnastics) were defined as leisure activities (e.g. gardening, ceramic art). The intensity of physical activity for leisure activities ranged between 1.5 and 2.5 metabolic equivalents (Mets). These activities were chosen from those that the caregiver considered possible to perform on a continuing basis, e.g. gardening, drawing (sketching), watercolour painting, calligraphy, woodcarving, singing/karaoke, playing instruments

(e.g. castanet, harmonica), cooking (other than everyday foods), creating (e.g. handcrafts), and tea ceremony/flower arrangement.

Intervention

After participants were randomly assigned to one of the two groups, those assigned to the intervention group were asked to choose a specific leisure activity from a list that could be enjoyed and continued together with care recipients (who were also interested in the activity), and could be incorporated into the participants' daily routine relatively easily. As a general rule, intensities of these leisure activities were equivalent to 1.5–2.5 Mets of physical activity. Non-listed activities with comparable physical intensities were also permitted. The intervention group was instructed to continue a leisure activity program three times a week (30 min each) for 24 weeks together with care recipients, while the non-intervention group underwent normal care activities.

Activities excluded as leisure activities included reading, working on computers, listening to music, and activities that do not require continuous use of hands and fingers. In other words, activities involving only one action over a few minutes and minimal physical activity were excluded as leisure activities.

Cognitive and neuropsychiatric assessments

As a simple tool to evaluate the cognitive function of dementia patients, we used the Japanese version of the Mini-Mental State Examination (MMSE; Folstein *et al.*, 1975), one of the most widely used screening instruments to assess cognition. Details of the MMSE have been described elsewhere. The Japanese version of the Neuropsychiatric Inventory (NPI) was used to assess psychological and behavioral disturbances in dementia patients (Hirano *et al.*, 1997). The NPI consists of questions about the frequency and severity of ten psychopathological symptoms in care recipients. Each item had a maximum score of 12 points, for a total possible NPI score of 120.

Statistical analysis

Statistical data were analyzed with SPSS Ver 20.0. Unpaired *t*-tests were used to compare baseline characteristics between the two groups. Comparisons before and after intervention in the two groups were performed with a paired *t*-test. $p < 0.05$ was considered statistically significant.

Ethical considerations

This study was approved by the Nagoya University Department of Medicine Ethics Committee, and written consent for participation was obtained from participants. Ethical considerations were made to ensure that participation was voluntary.

Results

Of the 54 recruited participants, 2 declined after enrollment and 10 dropped out during the program. The reason for dropping out was difficulty continuing the intervention due to circumstances in the caregiver's life. Twenty one participants in the intervention group periodically carried out leisure activities (39.0 ± 7.5 min/per session, 3.0 ± 0.2 days/week, for 24 weeks; drawing (sketching), watercolour painting, calligraphy, woodcarving, playing instruments (e.g. harmonica), cooking (other than everyday foods), and creating (e.g. handcrafts)), and another 21 participants were allocated to the control group. Thus, the study was carried out with a total of 42 participants (59.5% female; mean age \pm SD, 75.0 ± 4.7 years).

Table 1 shows baseline participant characteristics. There were no significant differences between the two groups.

Table 2 shows changes in measured values from baseline. The ZBI score significantly decreased after intervention in the intervention group ($p < 0.05$), while no significant difference was observed in the control group.

With respect to endocrine hormones, mean levels of adrenaline, dopamine, and cortisol increased, while SBP and DBP decreased, in the intervention group. In the control group, mean levels of all endocrine hormones decreased. There were no significant differences in the levels of adrenaline, noradrenaline, dopamine, and cortisol between the intervention and control groups.

Discussion

This study demonstrated the efficacy of periodic leisure activities in reducing perceived care burden in caregivers living with Alzheimer's dementia patients. While mean levels of endocrine hormones other than noradrenaline increased in the intervention group, and those of all endocrine hormones decreased in the control group, no significant difference in levels was noted between the two groups.

ZBI scores decreased significantly after intervention in the intervention group ($p < 0.05$), while no significant difference was observed in the control

Table 1. Baseline participant characteristics

	TOTAL (N = 42)			INTERVENTION GROUP (N = 21)			CONTROL GROUP (N = 21)			p
	MEAN (N)	SD		MEAN (N)	SD		MEAN (N)	SD		
caregiver										
Sex (M/F), n/%	17/25		40.5/59.5	10/11		47.6/52.4	7/14		33.3/66.7	0.36
Age	75.0	±	4.7	73.9	±	4.5	76.2	±	4.7	0.12
Care duration (months)	44.7	±	32.3	52.2	±	29.7	37.1	±	33.6	0.13
Daily care duration (hrs)	8.5	±	6.4	8.0	±	6.1	9.1	±	6.7	0.55
Hypertension (n/%)	21	/	50.0	8	/	38.1	13	/	61.9	0.13
Diabetes (n/%)	7	/	16.7	4	/	19.0	3	/	14.3	0.69
Dyslipidemia (n/%)	6	/	14.3	3	/	14.3	3	/	14.3	1.00
Others (n/%)	20	/	47.6	9	/	42.9	11	/	52.4	0.73
ZBI score	30.4	±	16.3	31.4	±	17.2	29.4	±	15.6	0.70
Adrenaline	39.6	±	23.5	42.6	±	22.4	36.6	±	24.8	0.42
Noradrenaline	617.5	±	202.7	616.3	±	229.9	618.6	±	177.1	0.97
Dopamine	25.8	±	18.7	22.0	±	18.4	29.5	±	18.8	0.20
Cortisol	10.8	±	3.1	10.2	±	3.3	11.3	±	2.8	0.25
Aldosterone	96.2	±	45.0	104.1	±	54.3	88.3	±	32.7	0.26
Renin	29.7	±	82.8	11.5	±	12.8	47.9	±	114.9	0.16
Total physical activity	2.2	±	0.8	2.2	±	0.7	2.3	±	0.8	0.59
Housework score	2.0	±	0.5	1.9	±	0.5	2.1	±	0.4	0.28
Sports score	0.2	±	0.6	0.3	±	0.5	0.2	±	0.6	0.90
Leisure score	0.0	±	0.0	0.0	±	0.0	0.0	±	0.0	0.32
Pulse (beats/min)	73.0	±	8.9	73.2	±	9.5	72.8	±	8.5	0.89
Systolic BP (mm Hg)	137.4	±	18.8	135.3	±	20.9	139.4	±	16.6	0.49
Diastolic BP (mm Hg)	80.5	±	9.7	80.3	±	10.5	80.7	±	9.1	0.90
BMI	22.9	±	3.5	23.0	±	2.9	22.9	±	4.0	0.98
patient										
Age	76.5	±	6.1	75.3	±	6.7	77.7	±	5.3	0.22
MMSE	18.0	±	7.5	17.6	±	7.4	18.4	±	7.7	0.73
NPI	13.7	±	13.9	14.8	±	12.8	12.6	±	15.1	0.62
Length of disease (months)	48.1	±	31.8	55.9	±	31.0	40.3	±	31.3	0.11

* $p < 0.05$; ** $p < 0.01$.

Data are presented as mean ± SD.

SD, Standard Deviation; ZBI, Zarit Burden Interview; BP, Blood Pressure; BMI, Body Mass Index; MMSE, Mini-Mental State Examination; NPI, Neuropsychiatric Inventory.

group. Thus, participation in a program involving leisure activities which aimed to increase physical activity levels improved ZBI scores and temporarily reduced stress in the present study. Increased caregiver burden was reported to increase the risk of developing depression in caregivers (Kuroda *et al.*, 2007). It was also reported that caregivers with

higher burden showed a decrease in the negative effects associated with increased satisfaction with leisure activities (Mausbach *et al.*, 2011). We believe that the home-based leisure program in the present study, which was designed to comply with the caregiver's pace of life, not only allowed participants to enjoy what the program offers but also provided

Table 2. Changes in outcomes after intervention

	INTERVENTION GROUP (N = 21)			CONTROL GROUP (N = 21)				
	MEAN	SD	<i>p</i>	MEAN	SD	<i>p</i>		
caregiver								
ZBI	-3.1	±	0.1	0.031*	1.3	±	1.7	0.54
Adrenaline	1.3	±	9.1	0.747	-0.5	±	1.3	0.90
Noradrenaline	-23.1	±	-51.6	0.558	-13.8	±	50.2	0.67
Dopamine	4.1	±	0.4	0.293	-5.9	±	-2.4	0.21
Cortisol	0.5	±	-0.1	0.490	-0.6	±	-0.6	0.33
Aldosterone	0.3	±	-0.4	0.972	-4.9	±	-4.9	0.56
Renin	0.1	±	-1.2	0.906	-29.0	±	-69.4	0.13
Total physical activity	0.4	±	0.2	0.003**	0.1	±	0.2	0.43
Housework score	-0.0	±	-0.1	0.832	0.0	±	-0.0	0.85
Sports score	0.2	±	0.2	0.145	0.1	±	0.2	0.26
Leisure score	0.3	±	0.2	0.000**	0.0	±	0.0	0.33
Pulse (beats/min)	1.1	±	0.7	0.479	0.3	±	2.4	0.87
Systolic BP (mm Hg)	-2.5	±	-5.7	0.563	-2.9	±	1.4	0.41
Diastolic BP (mm Hg)	-1.6	±	-0.3	0.510	-2.7	±	2.0	0.22
patient								
MMSE	0.0	±	0.4	1.000	-0.8	±	1.1	0.26
NPI	-1.8	±	-2.7	0.45	-3.6	±	-6.9	0.26

Change after intervention (Δ) = post-intervention value - baseline value.

* $p < 0.05$; ** $p < 0.01$.

Data are presented as mean \pm SD.

SD, Standard Deviation; ZBI, Zarit Burden Interview; BP, Blood Pressure; NPI, Neuropsychiatric Inventory.

them with temporary relief from the care burden they may perceive as constant.

Unchanged overall MMSE scores for care recipients in the intervention group suggest that decreased care burden of caregivers may have had a positive effect on cognition of care recipients. Caregivers as well as care recipients may have also been involved in leisure activities. Therefore, potential increases in physical activity among the care recipients could have led to the maintenance of cognitive function observed in the present study.

Given that stress plays a role in the pathophysiology of many diseases (Chrousos, 2009), psychological stress from perceived care burden may contribute to disease onset. Regardless of type, stress is known to cause a non-specific systemic response (Cannon, 1935) which is regulated by the hypothalamic-pituitary-ACTH-adrenal hormone axis. Stress also exacerbates infectious and allergic diseases (Glaser and Kiecolt-Glaser, 2005). Large amounts of serotonin and noradrenaline are released from synaptic vesicles in response to psychosocial stress (Tanaka *et al.*, 1990), and in response, hyperactivation of the sympathetic nervous system leads to physiological changes in the cardiovascular system (e.g. increased blood pressure and arrhythmia) (Amaral, 2002; Tranel *et al.*, 2006) and circulatory diseases (Jiang *et al.*, 1996).

In general, when levels of endocrine hormones decrease, the consequent alleviation of nervousness leads to a change of pace, and the caregiver is temporarily relieved from care-related stress. Yet, in this study, we found that mean levels of adrenaline, dopamine, and cortisol increased in the intervention group, while SBP and DBP decreased. Moreover, in the control group, while the mean levels of all assessed hormones decreased, no significant differences in adrenaline, noradrenaline, dopamine, and cortisol levels were found between the intervention and control groups. One possible explanation for this is that adrenaline, noradrenaline, and dopamine secretion increased due to hyperactivation of the sympathetic nervous system when participants carried out leisure activities they enjoyed. An important consideration is that baseline standard deviations of adrenaline, noradrenaline, and dopamine levels were statistically variable, and inter-individual differences in data were considerable. Also, while we attempted to collect blood at the same time of the day each time, it is possible that caregiver stress at blood collection, changes in stress in daily life, or differences in physical condition among participants resulted in different levels of adrenaline secretion. Indeed, secretion of the assessed endocrine hormones is known to vary widely with stress. Diurnal variation is also a

major issue; AUC (Area Under the Curve) analysis with measurements over time may have been an appropriate way to address this issue.

There were no significant differences between aldosterone and renin levels between the intervention and control groups. Thus, we suspect that the levels of these hormones were stable despite the fact that stimulation of the sympathetic nervous system is known to increase their levels.

Negative experiences such as anxiety increase cortisol levels (Jin, 1992), while psychological improvements through exercise have the opposite effect (Rudolph and McAuley, 1995). In the present study, no significant difference in cortisol levels were observed in the intervention group. Cortisol is secreted almost immediately after awakening, and its levels decrease thereafter, resulting in a large diurnal variation (Kirschbaum and Hellhammer, 1989). Given that the timing of blood collection in the morning corresponded to the time at which cortisol levels begin to decrease, it is possible that the effects of slight stress may not have been apparent. Moreover, cortisol levels increase in proportion to exercise intensity and time (Rudolph and McAuley, 1998). Since elderly caregivers busy with care obligations likely performed the interventions numerous times and/or for long periods, the interventions may have physically burdened them due to difficulties with accommodating and balancing both care obligations and interventions, or due to the simple increase in physical activity.

Providing a structured activity program with fixed leisure activity contents, physical activity intensity, and number of times allowed us to maintain the quality of the interventional study. In the future, a program that can be conducted at home periodically (e.g. twice a week for 20 min each) will need to be developed in order to further reduce the perceived psychological burden of caregivers.

This study has some limitations worth noting. First, although blood was collected after 24 weeks, levels of the assessed hormones exhibit strong diurnal variations which are easily influenced by the stress each participant feels. Thus, the unstable nature of hormone levels and individual variations may have made it difficult to observe a significant result. Developing a method for continuous monitoring or finding surrogate markers that correlate well with a perceived sense of burden may help understand how the program influences the health and stress of caregivers. Other factors related to care recipients, such as type of dementia or length of disease, may have affected the results. Future studies that take into consideration these factors are warranted. Finally, the number of participants in this study was small; it will be

necessary in the future to increase the size of the sampled population. There is also a need for long-term follow-up in order to accurately assess the effects of the program described herein, as well as a need to develop an activity program that is tailored to the degree of perceived care burden.

Conflict of interest

None.

Description of authors' roles

Akemi Hirano and Hiroyuki Umegaki conceived the idea and designed the study. Akemi Hirano carried out data analysis and interpretation. Akemi Hirano wrote the first draft of the manuscript, and Hiroyuki Umegaki and Yusuke Suzuki critically reviewed all versions of the manuscript and appraised the final version prior to submission. Toshio Hayashi recruited the participants, and Masafumi Kuzuya contributed to the overall supervision of the present study.

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The prevalence of homebound individuals in the elderly population: a survey in a city area in Japan

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ABSTRACT

Being homebound has been reported to be associated with a number of conditions. In the current study, the incidence of homebound individuals was surveyed in an urban city area in Japan. The city office randomly enrolled 5,000 residents of Nagoya City aged 65 and over. A questionnaire was sent to their principal caregivers by mail, and 3,444 (68.9 %) subjects returned the survey. The investigators obtained the totally anonymous data from the city office. This study was approved by the Ethics Committee of Nagoya University Graduate School of Medicine. In the present study, the data of 3,053 (61.1 %) subjects for whom complete sets of data were available were employed for statistical analysis. The questionnaire included the following items: age, sex, the status of public long-term care insurance certification (none, support-level, care-level), self-rated health (good, fair, poor, very poor), states of living (single living, with only spouse, with other family members), and the frequency of outside excursions per a week (every day, once in a few days, once a week, rarely). An individual was defined as being homebound if his or her frequency of outside excursions was less than once per week. The incidence of the homebound elderly in the elderly population over 65 years old was 14.4 % in the current study. The status of certification in public long-term care insurance was associated with being homebound. Self-rated health was significantly worse in homebound individuals than in those non-homebound. The current survey found 14.4 % of the elderly was home-bound in a large city in Japan.

Key Words: long-term care insurance, homebound, self-rated health

INTRODUCTION

In Japan, the elderly population has been growing. With the increasing aging of society, the number of homebound elderly is growing.¹⁾ Homebound older adults are confined to their homes because of physical, psychiatric, and social limitations. Being homebound is associated with a number of conditions, including low basic and instrumental activities of daily living, psychiatric diseases, such as dementia, physical illness, and malnutrition.^{2,3)} Moreover, several reports have indicated that being homebound is associated with a high mortality rate.^{4,5)} The decrease in the number of opportunities to go out may itself be a consequence of poor health. Alternatively, the loss of the opportunity to leave the home may lead to both physical and mental disuse. Social

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relationships are known to be one of the core elements of quality of life for seniors.⁶⁾ Being homebound is also associated with social isolation.

The public long-term care insurance (LTCI) system was introduced in 2000 to meet the increasing need for elder care in the rapidly aging society of Japan.⁷⁾ LTCI provides services according to care levels 1–5 and support levels 1 and 2.^{8,9)} The individuals who need continuous care are classified into one of the care levels according to their mental or physical disabilities, whereas those who need support for daily activities but do not need care are classified as support level 1 or 2. The relationship between certification by LTCI and being homebound should be investigated.

Self-rated health has been reported to be associated with mortality¹⁰⁻¹²⁾ and functional declines.¹³⁾ Being homebound is associated with various factors, including health status.^{2,3)} The association between homebound status and self-rated health, however, has not been reported.

An epidemiological survey of the homebound elderly in Japan would provide useful information in terms of considering intervention and policy making. In the current study we aimed to clarify the incidence of homebound in the elderly in a city in Japan.

MATERIALS AND METHODS

This study was performed in Nagoya City, which is located in the central part of Japan. Nagoya City has a population of 2,261,377 (April 2010), of whom 21.4 % are 65 years of age or older. This study was developed and organised by Nagoya City and was supported by the Department of Community Healthcare & Geriatrics of the Nagoya University Graduate School of Medicine. The study was approved by the ethical committee in Nagoya University Graduate School of Medicine on March 26, 2014 (#4233). Written informed consent was obtained from all participants. The city office randomly enrolled 5,000 of all of the residents of Nagoya City aged 65 and over. A questionnaire was sent at September 1, 2010 by mail, and 3,444 (68.9 %) subjects returned the survey by 15 October, 2010. The investigators obtained the totally anonymous data from the city office. In the present study, the data of 3,053 (61.6 %) subjects for whom complete sets of data were available were employed for statistical analysis. The questionnaire included the following items: age, sex, the status of public LTCI certification (none, support-level, care-level), self-rated health (good, fair, poor, very poor), states of living (single living, with only spouse, with other family members), and the frequency of excursions per week (every day, once in a few day, one a week, rarely) including day care service usage in LTCI.

Being homebound was defined in the current study as a frequency of excursions per a week that was less than once a week.

χ^2 analyses for the categorical variance were performed for the statistical analysis. Statistical significance was set below the p value of 0.05.

RESULTS

Approximately 54.0 % of the responders went out every day, 31.6 % went out once every few days, 9.0 % went out once in a week, and 5.4 % went out rarely. The frequency of going-out distributed differently in men and women ($p < 0.001$) (Fig. 1). In the current study, being homebound was defined as going out less than once per week. The proportion of the homebound elderly in the elderly population over 65 years-old was 14.4 % in this setting. As the age of the population increase, the proportion of homebound elderly increased ($p < 0.001$). With respect

Prevalence of homebound elderly

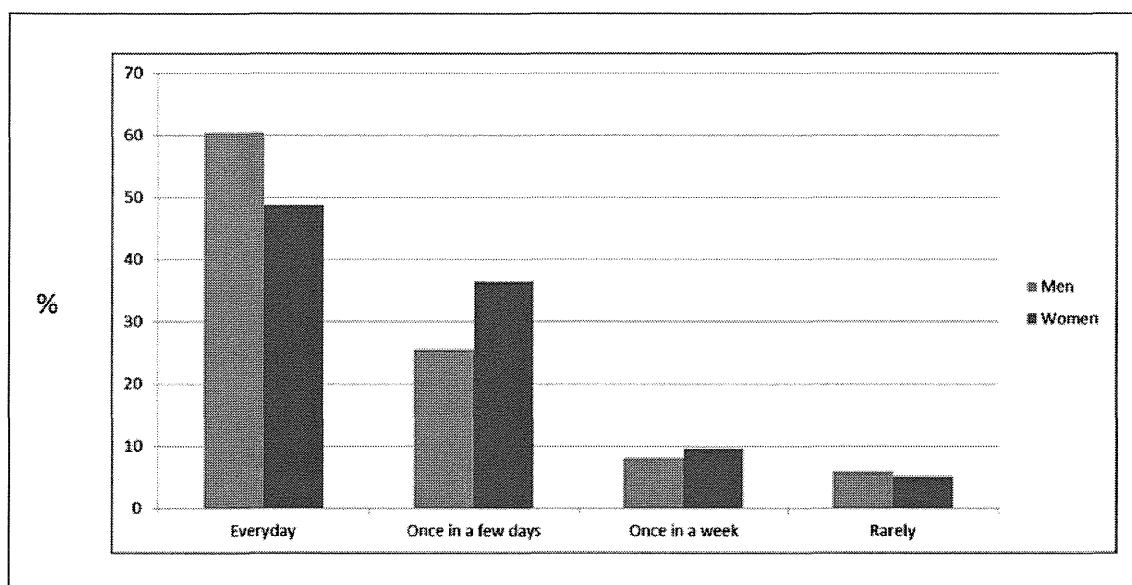


Fig. 1 The distribution of the frequency of excursions in the elderly over 65 years old. Approximately 14.4% of the elderly over 65 years old went out once a week or less.

Table 1 Rate of the homebound according to age and sex

Age	Male		Female		p value
	Total	Homebound	Total	Homebound	
65-69	436	32 (7.3%)	517	39 (7.5%)	0.503
70-74	380	40 (10.5%)	418	39 (9.3%)	0.327
75-79	288	44 (15.7%)	306	44 (12.7%)	0.192
80-84	164	34 (20.7%)	233	61 (26.2%)	0.128
85-	73	28 (38.4%)	119	40 (33.6%)	0.304
Total	1,364	192 (14.1%)	1,689	248 (14.7%)	

to the male population 7.3 % of men 65–69 years old, 10.5 % of men 70–74 years old, 15.7 % of men 75–79 years old, 20.7 % of men 80–84 years-old, and 38.4 % of men over 85 years old were homebound. With respect to the female population, 7.5 % of women 65–69 years old, 9.3 % of women 70–74 years old, 12.7 % of women 75–79 years old, 26.2 % of women 80–84 years old, and 33.6 % of women over 85 years old were homebound (Table 1). The trend of being homebound significantly increase with age ($p < 0.001$).

The χ^2 analysis did not identify any significant differences between males and females with respect to the frequency of homebound individuals in each age category.

Approximately 11.3 % (4.8 % for support levels, and 6.5 % for care levels) of the subjects involved in the study was certified by public LTCI. A 11.2% (311/2708) of the non-certified elderly, 33.8% (50/148) of the elderly with support levels, and 40.1% (79/197) of the ones with care levels was homebound. As the level of certification increased (support levels and care-need levels), the proportion of homebound individuals increased significantly in both men and women (Table 2). When stratified by age, more homebound individuals were observed among the non-

Table 2 Rate of homebound by the certified levels of public LTCI

	Total	Homebound	Men	Homebound in men	Woman	Homebound in woman
Non-certified	2708	311 (11.5%)	1246	145(11.6%)	1462	166 (11.4%)
Support levels	148	50 (33.8%)	38	14 (36.8%)	110	36 (32.7%)
Care levels	197	79 (40.1%)	80	33(41.3%)	117	46 (39.3%)

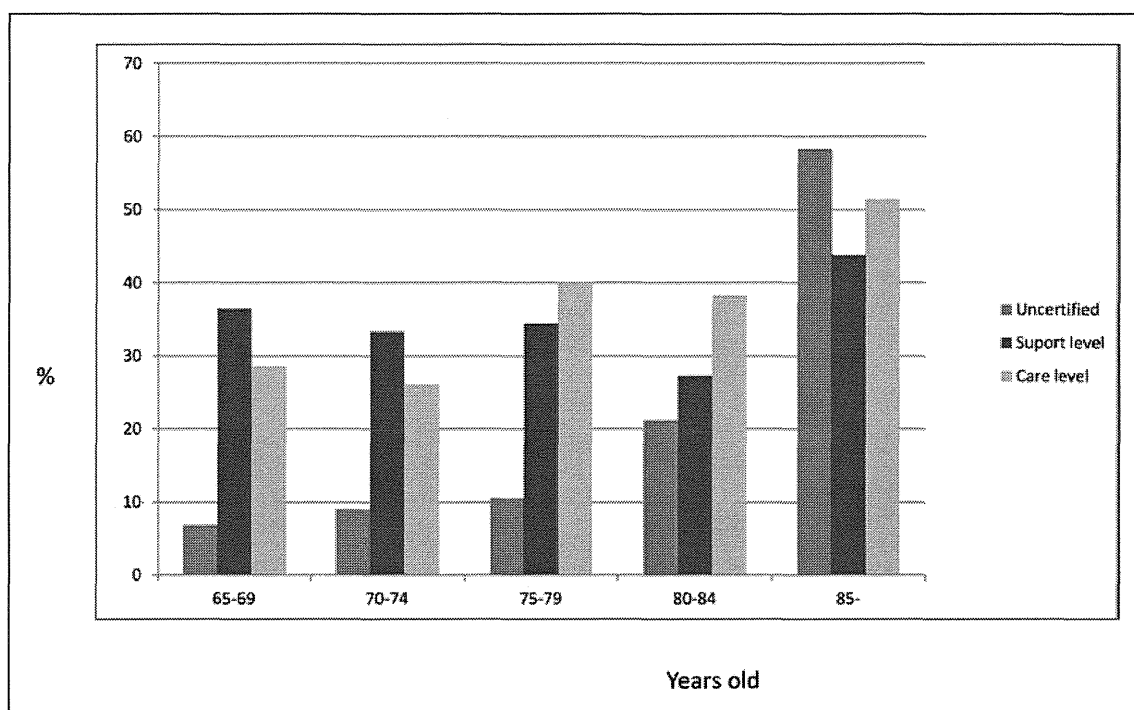


Fig. 2 The frequency of being homebound stratified by age and certified levels.
As the age increased, the proportion of homebound individuals increased among the non-certified subjects.

certified subjects as age increased (Fig. 2).

The status of the living situation (living alone, with spouse, with other family members, or, other) was not associated with being homebound ($p=0.355$). In men the distribution was not associated with the status of the living situation, while in women the distribution was significantly different according to the status of the living situation (Table 3).

Self-rated health was significantly worse among the homebound than among the non-homebound. Approximately 32.1 % of the non-homebound rated their health as good, 59.8 % as fair, 5.3 % as poor, and 2.8 % as very poor. Among the homebound, 12.3 % rated their health as good, 52.8 % as fair, 15.7% as poor, and 19.2 % as very poor (Fig. 3). Overall, the homebound rated their health as significantly worse ($p<0.001$).

Multiple logistic analysis with sex (male=1, female=0), age (5 year category), status of certification of LTCI (non-certified=0, support level=1, care level=2) showed that age (odds ratio 1.517; 95% confidential interval 1.402–1.642, $p<0.001$) and certification level (odds ratio 1.746; 95% confidential interval 1.484–2.054, $p<0.001$) were positively associated with homebound.

Prevalence of homebound elderly

Table 3 Rate of the homebound by the living status

	Total	Homebound	Men	Homebound in men	Woman	Homebound in woman
Living alone	543	73 (13.4%)	159	19 (11.9%)	384	54 (14.1%)
With spouse only	1274	173(13.6%)	692	102 (14.7%)	582	71(12.2%)
With other members of family	1118	173 (15.5%)	460	65 (14.1%)	658	108 (16.4%)
Others	118	21 (17.8%)	53	6 (11.3%)	65	15 (23.1%)

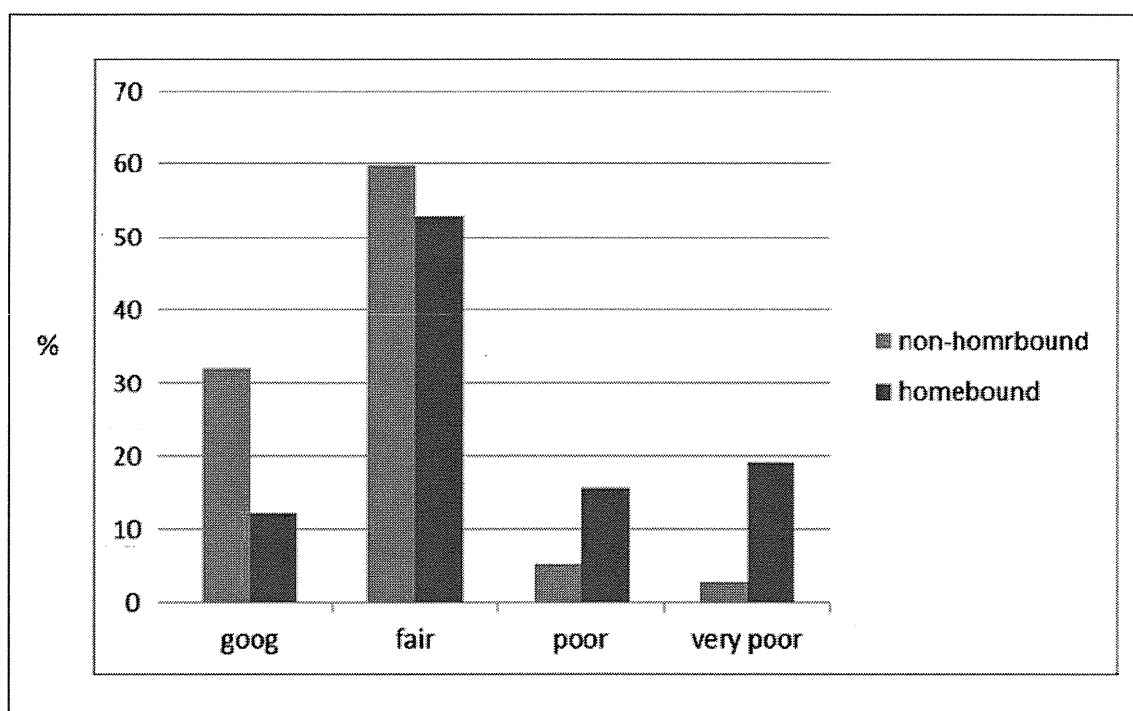


Fig. 3 Self-rated health of the elderly over 65 years old.
The homebound rated their health significantly worse ($p < 0.001$).

DISCUSSION

In the current survey performed in a city area in Japan, approximately 14.4 % of the population over 65 years old was homebound. The rate increased with aging and increased certified levels in LTCI.

Estimates of how many elderly persons are homebound range from 10.3 % to more than 30.0 %.^{14,15)} A rate of 10.6 % was reported by a study in a rural area in Japan.¹⁶⁾ A study from Israel reported a prevalence of 17.7–19.5 %.¹⁷⁾

Several studies in United States^{14,17)} and in UK¹⁸⁾ reported that women are more prone to being homebound, and several Japanese studies also showed the same trend.^{19,20)} However, in the current survey, we did not observe any sex differences among the prevalence of the homebound. The analysis divided by the certified levels of public LTCI and the living status did not show the difference of homebound prevalence between men and women in the current study. Lower

education and income may be speculated to explain the female dominance in the previous studies; social and cultural backgrounds should be further studied.

Ganguli *et al.* reported that being widowed was a risk for being homebound.¹⁴⁾ In the current survey, single living status was not associated with being homebound. The ability to live alone may be associated with better health status, cognitive function, and activities of daily livings. LTCI provides services according to support levels 1 and 2 and care levels of 1–5.^{8,9)}

People certified as care level require more assistance. In the current survey, the prevalence of the homebound increased according to the increase in the LTCI certification levels.

Japanese public LTCI provides day-care services.⁷⁻⁹⁾ The homebound individuals with LTCI certification might not fully use these services. Taking advantage of day-care service may create opportunities for the homebound beneficiaries. Our previous study demonstrated that the introduction of services provided by public LTCI significantly reduced care-giver burden.²¹⁾ Among the older subjects, more non-certified subjects tended to be homebound. The reasons for this association remain to be elucidated. The LTCI certification is largely based on functional ability and cognitive dysfunction. The older subjects may have other reasons for be homebound. Depressive mood may be speculated to be one of the associated factors.^{4,22)}

Self-rated health is reportedly associated with decreased survival or function.¹³⁾ In the current survey, we observed significantly lower self-rated health in the homebound. Nearly 90 % of the homebound rated their health as fair, poor, or very poor. Lower health status secondary to disease effects may cause homebound status. A study found that lower self-rated health was associated with depressive mood.²³⁾ As stated previously, depressive mood is also a risk for homebound.^{4,22)} Elderly individuals with depression are likely included in the homebound found in the current study. Further investigation and intervention is warranted. A study reported that being homebound was not necessarily due to an impairment in mobility or IADL.¹⁶⁾ Approximately 11.7 % of the homebound evaluated their health status as good. The reasons why this group did not go out should be further investigated.

The current survey was performed in a metropolitan area in Japan. Compared to rural areas, urban areas tend to have better transportation systems, which may protect against becoming homebound, but fewer social relationships in the community, which may contribute to becoming homebound. A study reported that the neighbourhood environments affect the walking of the elderly.²⁴⁾ Another study from Japan reported that feasibility of access in the neighbourhoods was associated with homebound status.²⁵⁾

The housing environment including public transportation system and shopping services also differs in rural and urban areas. The current rate of the homebound elderly should be compared with some rural areas.

The survey was based on a self-report, which is a major limitation in the current study. Depressive mood may be a factor associated with being homebound; however, in the current study, we did not assess depressive mood, which is another limitation. Further, we were only able to analyse 63.4 % of the initial 5,000 subjects who were invited to participate in the survey by mail. The non-responders could include more homebound subjects. The interpretation of the results requires some caution.

CONCLUSIONS

We observed that 14.7 % of the population over 65 years old in a city area in Japan were homebound. The prevalence of being homebound increased according to age. The relatively high rate of homebound status in the elderly population requires increased medical and political

attention.

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