Table 1
Selected variable characteristics of participants at baseline by study group, mean ± S.D.[a]

Variables	Intervention group	Control group	$p^{\dagger}$
Number	31	30	
Age (year)[a]	79.0 ± 3.9	78.1 ± 4.4	0.424
Height (cm)	146.9 ± 5.4	147.0 ± 5.8	0.940
Body weight (kg)	47.4 ± 6.4	50.7 ± 9.1	0.108
BMI (kg/m^2)	22.0 ± 2.6	23.4 ± 3.6	0.084
One leg standing time (s)	29.2 ± 23.5	34.6 ± 22.8	0.367
Tandem walking (step)	7.2 ± 4.7	7.8 ± 4.7	0.631
Functional reach (cm)	31.0 ± 7.1	33.2 ± 4.9	0.167
Grip strength (kg)	16.5 ± 4.3	17.9 ± 4.7	0.239
Adductor muscle strength (kg)	17.3 ± 4.0	18.0 ± 5.1	0.740
Usual walking speed (m/s)	1.1 ± 0.3	1.2 ± 0.2	0.685
Maximal walking speed (m/s)	1.7 ± 0.4	1.7 ± 0.4	0.979
TMIG index score (point)	10.6 ± 1.6	10.4 ± 1.5	0.654
Urinary incontinence, yes (%)	64.5	50.0	0.252
Functional decline, yes (%)	51.6	43.3	0.517
Fear of falling, yes (%)	67.7	76.7	0.390
Chronic medical conditions, yes (%)			
Hypertension	58.1	60.0	0.902
Stroke	13.2	13.3	0.988
Diabetes	19.4	20.0	0.948

[†] Two group *t*-test for continuous variables and the χ^2-test for categorical variables.

exercise and control group were analyzed using *t*-test for the continuous variables and Chi-square test for the categorical variables. The changes in dependent variables pre-intervention, post-intervention and follow-up in the exercise and control group were analyzed using an analysis of variance (ANOVA) with repeated measures. Significant interactions were analyzed to determine whether or not the effects were greater in the intervention than the control group. Cochran's *Q*-test was used to evaluate within-group differences of the effect of the exercise on the categorical variables for pre-intervention, post-intervention, and follow-up data. In the case of items which were showing significant differences, a post hoc analysis was performed using McNumar's test. One-way ANOVA was performed to evaluate the within-subgroup effect of the intervention on multiple geriatric syndrome scores at baseline, after the 3-month exercise, and at 6-month follow-up. For the subgroup showing significant differences, a post hoc analysis was performed using Scheffe's method. The percentage improvement in physical fitness was calculated using the following formula: % improvement = {(after 3-month exercise or at 6-month follow-up values – baseline value)/baseline value × 100}. The percentage improvement was divided into tertiles. The power of the current study was calculated at 80% to demonstrate a difference in the outcome variable of at least 20% at a significance level of alpha = 0.05. All the analyses were performed using the SPSS software package for Windows version 15.0 (SPSS, Inc., Tokyo, Japan).

3. Results

There were no significant differences between the groups in any of the baseline characteristics such as age, BMI, walking speed, adductor muscle strength, functional decline, urinary incontinence, fear of falling, and chronic medical conditions (Table 1).

Attendance 15 (62.5%) or more than of the exercise sessions (24) was defined as trial completion. Two participants (3.3%) could not complete the trial after the randomization because of hospitalization ($n = 1$) and fracture ($n = 1$) (Fig. 1). The mean attendance rate was 77.4% (61.3–90.3%) during the intervention period and 74.2% during the follow-up. In the exercise group, 32.3% of the subjects attended the exercise sessions 24 times, 22.6% attended 20–23 times, 35.5% attended 16–19 times, 6.5% attended 15 times, and 3.3% attended 14 or less of the exercise sessions. During the follow-up, the mean frequency of performing the

Table 2
Comparison of physical fitness and geriatric syndrome variables between intervention = I (n = 30) and control = C (n = 29) groups after 3-month exercise and at 6-month follow-up, mean ± S.D.

Variables	Gr	Baseline	3-Month exercise	6-Month follow-up	ANOVA F=	p=
Body weight (kg)	I	46.6 ± 5.4	47.4 ± 5.4	47.1 ± 5.4	(1,57)= 2.74 ½	0.105
	C	51.0 ± 9.5	51.0 ± 9.4	50.6 ± 9.1 ½		
BMI (kg/m^2)	I	21.5 ± 2.2	21.9 ± 2.2	21.8 ± 2.2	(1,57)= 2.82	0.100
	C	23.4 ± 3.9	23.4 ± 3.8	23.3 ± 3.6		
One leg standing time (s)	I	34.0 ± 24.2	28.2 ± 20.4	32.4 ± 22.6	(1,57)= 0.01	0.920
	C	33.4 ± 23.4	28.8 ± 23.5	32.4 ± 24.6		
Tandem walking (step)	I	7.2 ± 4.7	6.1 ± 4.5	5.9 ± 3.3	(1,57)= 4.70	0.036
	C	7.8 ± 4.7	5.2 ± 3.8	3.5 ± 2.0		
Functional reach (cm)	I	31.7 ± 6.8	33.5 ± 5.13	3.5 ± 4.4	(1,56)= 4.18	0.046
	C	33.7 ± 4.7	32.7 ± 5.3	31.6 ± 8.8		
Grip strength (kg)	I	17.2 ± 4.0	20.9 ± 5.2	17.9 ± 4.7	(1,57)= 0.02	0.874
	C	18.0 ± 4.6	21.5 ± 5.1	18.6 ± 4.8		
Adductor muscle strength (kg)	I	17.2 ± 4.0	18.9 ± 5.1	19.3 ± 4.7	(1,57)= 4.18	0.045
	C	17.9 ± 5.0	18.2 ± 4.01	17.8 ± 3.7		
Usual walking speed (m/s)	I	1.1 ± 0.3	1.1 ± 0.2	1.2 ± 0.2 ½	(1,57)= 13.03	0.001
	C	1.2 ± 0.2	1.1 ± 0.3	1.1 ± 0.3		
Maximal walking speed (m/s)	I	1.7 ± 0.4	1.8 ± 0.5	1.8 ± 0.4	(1,56)= 4.24	0.044
	C	1.7 ± 0.4	1.6 ± 0.4	1.6 ± 0.4		
Functional decline, yes (%)	I	50.0	16.7	16.7	16.67[a]	<0.001
	C	41.4	31.0	27.6	4.10[a]	0.109
Urinary incontinence, yes (%)	I	66.7	23.3	40.0	13.56[a]	0.001
	C	51.7	44.8	44.8	4.00[a]	0.135
Fear of falling, yes (%)	I	66.7	70.0	70.0	0.17[a]	0.920
	C	75.9	62.1	75.9	2.91[a]	0.234

[a] Cochran's *Q*-value.

Table 3
Improvement of MSGS according to maximum walking speed and adductor muscle strength tertiles in intervention group.

Survey variable	Changes compared to baseline[a]	Improvement of MSGS[†] *n* (%)	Cochran's Q-value	*p*	Post hoc[‡]
3-Month exercise (*n*=8)					
Maximum walking speed	Increased	3 (37.5)	2.80	0.247	
	No change	4 (50.0)			
	Decreased	1 (12.5)			
Adductor muscle strength	Increased	3 (37.5)	0.50	0.779	
	No change	3 (37.5)			
	Decreased	2 (25.0)			
6-Month follow-up (*n*=7)					
Maximum walking speed	Increased	5 (71.4)	6.50	0.039	In > De
	No change	1 (14.3)			
	Decreased	1 (14.3)			
Adductor muscle strength	Increased	3 (42.8)	0.57	0.713	
	No change	2 (28.6)			
	Decreased	2 (28.6)			

[a] Decreased (De) means lower range (0.0–33.3%), no change (no) means medium range (33.4–66.6%), and increased (In) means upper range (66.7–100%) of tertile.

exercise series at home was 3.8 times per week (23.3% performed everyday, 50.0% 2-3 times per week, 26.7% once or less per week), while the mean exercise time was 29.0 min.

The exercise group showed significant improvement compared with the control group in muscle strength, walking speed and balance. There was a significant group by time interaction for tandem walking ($F = 4.70$, $p = 0.036$), functional reach ($F = 4.18$, $p = 0.046$), adductor muscle strength ($F = 4.18$, $p = 0.045$), usual walking speed ($F = 13.03$, $p = 0.001$), and maximum walking speed ($F = 4.24$, $p = 0.044$) with significantly greater increases in the exercise group. The functional decline decreased significantly from 50.0% at baseline to 16.7% after the intervention and follow-up in the exercise group ($Q = 16.67$, $p < 0.001$), whereas the changes were not significant in the control group. Urinary incontinence was decreased significantly from 66.7% at baseline to 23.3% after the intervention and to 40.0% at the follow-up ($Q = 13.56$, $p = 0.001$) in the exercise group. However, no significant changes observed in the control group. There were no significant changes concerning fear of falling in either group (Table 2).

Fig. 2 shows the changes in the scores of multiple geriatric syndromes. As shown in Fig. 2, the intervention group showed greater and significant decrease compared with the control group ($F = 12.66$, $p = 0.001$). Within-group scores were compared, and significant changes were observed in intervention group, with the score of multiple geriatric syndromes decreasing significantly after 3-month exercise and at 6-month follow-up ($F = 16.89$, $p < 0.001$).

Eight subjects after 3-month intervention and seven subjects after 6-month follow-up were improved to normal status of multiple symptoms in the intervention group. Table 3 shows the distribution of the subjects who showed improvement to normal status of multiple symptoms according to the tertiles of maximum walking speed and adductor muscle strength. Within the subjects that showed improvement to normal status of multiple symptoms, a significantly higher proportion had an improved maximum walking speed at the 6-month follow-up ($Q = 6.50$, $p = 0.039$) compared with those having maintained or decreased walking speed. There was no difference at either time point in the proportion of the improved subjects with increased adductor muscle strength.

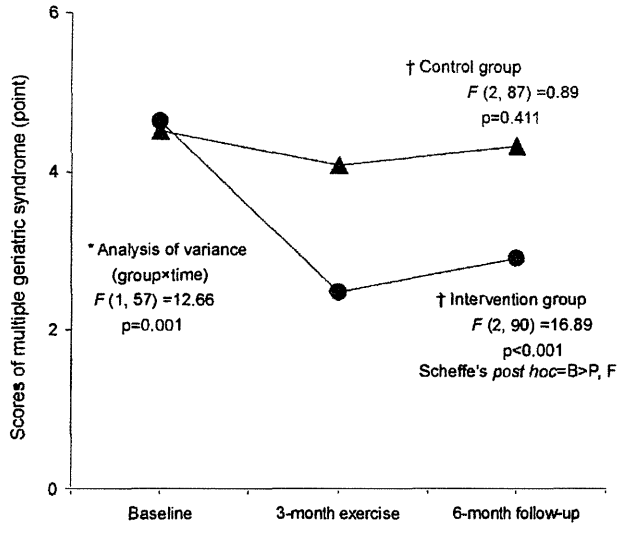

Fig. 2. Change in mean scores of MSGS at baseline, after 3-month exercise, and at 6-month follow-up in intervention (●) and control (▲) group. (*) Comparison of multiple geriatric syndrome scores between intervention and control group. (†) Comparison of within-group multiple geriatric syndrome scores at baseline (B), after the 3-month exercise (P), and at 6-month follow-up (F).

4. Discussion

This study demonstrates that the 3-month, multidimensional exercises, consisting of progressive strength training, balance and walking ability exercises along with PFM exercises, improved the usual walking speed, maximum walking speed, abductor muscle strength, tandem walking and functional reach in community-dwelling elderly women with MSGS. Furthermore, the increment of the physical fitness components appeared to contribute greatly to the improvement of the functional decline, urinary incontinence, and multiple symptoms. Therefore, the results of this study suggest that the improvements of the muscle strength, walking speed, and balance, which have been reported as risk factors for geriatric syndromes, may be effective in the improvement of geriatric syndrome.

Several studies of multidimensional intervention trials have reported beneficial effects (Tinetti et al., 1994; Shumway-Cook et al., 1997; Nelson et al., 2004; Gitlin et al., 2006; Kim et al., 2007). In a recent study, Gitlin et al. (2006) conducted a multidimensional home-based intervention in elder adults with functional difficulties, and confirmed that activity of daily living (ADL), instrumental ADL, self-efficacy, fear of falling, and home hazards were all improved and that the effects were sustained even after 6-month. Kim et al. (2007) assessed the effect of PFM and fitness exercises in improving urinary incontinence in elderly community-dwelling Japanese with stress urinary incontinence, and confirmed that

decrease in BMI and increase in walking speed may contribute to the treatment of urinary incontinence.

In this study, the prevalence of the functional decline decreased significantly from 50.0% before the intervention to 16.7% after intervention and follow-up. The cure rate of urinary incontinence was 43.3% after the 3-month exercise and 26.7% at 6-month follow-up for the intervention group. On the other hand, no significant improvement was observed in the control group. The effects of this multidimensional exercise affecting only a single symptom of urinary incontinence or functional decline were consistent with previously reported studies. Although the previous studies using multidimensional intervention were targeted to treat only a single geriatric syndrome, the current study was aiming to treat MSGS. Our findings suggest that the multidimensional intervention was significantly effective in the improvement of geriatric syndrome.

We analyzed the relationship between the increment of the physical fitness components and the improvement of the multiple symptoms, despite the small sample size. We found an increment rate of 9.6% in adductor muscle strength after the 3-month exercise and a rate of 12.3% after the follow-up in the intervention group, whereas the changes were not significant for the control group. This difference in the increment rate of muscle strength is not considered to account for the difference in geriatric syndrome improvement rate. However, the proportion of the subjects with improved to normal status of multiple symptoms was significantly higher among those who demonstrated an increase in maximum walking speed at 6-month follow-up ($Q = 6.50$, $p = 0.039$). These results suggest that the increment of walking speed is a major factor for the improvement of the multiple symptoms present in this population. The increased walking ability probably allowed the subjects to increase their physical activity and consequently contributed to the improvement of their functional capacity. But, the current study's results were obtained based on a small sample size. The above relationships need to be further researched in a population study which would contain a larger number of subjects and for a longer follow-up period.

Despite the fact that many studies have reported that exercise is effective in reducing the fear of falling in the elderly (Tennstedt et al., 1998), our intervention had no effect on the fear of falling in both groups. This may be explained by the characteristics of the intervention provided in the present study. Our multidimensional exercises focused on increasing the physical function and did not provide measures such as psychological care. These findings indicate that the comprehensive strategy designed to reduce MSGS in community-dwelling elderly women should include not only exercises addressing to the improvement of the physical functions, but should also incorporate psychological care focusing on reducing the fear of falling.

This study has several limitations. Firstly, the functional decline, urinary incontinence, and fear of falling were assessed using self-reported data obtained through a face-to-face interview, and they were not confirmed by objective and clinical methods. However, several previous studies have indicated that self-reported data have high validity, reliability and objectivity in the analyses of the functional decline, urinary incontinence, and fear of falling (Smith et al., 1990; Howland et al., 1993; Resnick et al., 1994). Therefore, the use of data collected from interviews or self-recording in analyses has minor influence on the interpretation of the results of this study. Secondly, although this study indicates that improvement of physical fitness components such as muscle strength and walking ability contributes to the treatment of geriatric syndrome, it provides no explanation of the mechanism of how increasing functional fitness component improves multiple geriatric symptoms.

5. Conclusions

This study assessed the effects of multidimensional exercises on functional decline, urinary incontinence, and fear of falling in community-dwelling Japanese elderly women with MSGS. The intervention program targeted modification of physical fitness may contribute to a reduction of the functional decline and urinary incontinence, but was not a diminishing symptom over time concerning the fear of falling. Therefore, the intervention strategies designed to reduce MSGS in elderly persons should include not only exercises aiming to the improvement of the physical functions, but should also incorporate psychological care focusing on the reduction of the fear of falling.

Conflict of interest statement

The authors have no conflict of interest to disclose.

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References

Burgio, K.L., Matthews, K.A., Engel, B.T., 1991. Prevalence, incidence and correlates of urinary incontinence in healthy, middle-aged women. J. Urol. 146, 1255-1259.

Duncan, P.W., Weiner, D.K., Chandler, J., Studenski, S., 1990. Functional reach: a new clinical measure of balance. J. Gerontol. Med. Sci. 45, M192–M197.

Gitlin, L.N., Winter, L., Dennis, M.P., Corcoran, M., Schinfeld, S., Hauck, W.W., 2006. A randomized trial of a multicomponent home intervention to reduce functional difficulties in older adults. J. Am. Geriatr. Soc. 54, 809–816.

Howland, J., Peterson, E.W., Levin, W.C., Fried, L., Bak, S., 1993. Fear of falling among the community-dwelling elderly. J. Aging Health 5, 229–243.

Inouye, S.K., Studenski, S., Tinetti, M.E., Kuchel, G.A., 2007. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. J. Am. Geriatr. Soc. 55, 780–791.

Ishizaki, T., Watanabe, S., Suzuki, T., Shibata, H., Haga, H., 2000. Predictors for functional decline among nondisabled older Japanese living in a community during a 3-year follow-up. J. Am. Geriatr. Soc. 48, 1424–1429.

Kim, H., Suzuki, T., Yoshida, Y., Yoshida, H., 2007. Effectiveness of multidimensional exercises for the treatment of stress urinary incontinence in elderly community-dwelling Japanese women: a randomized, controlled, crossover trial. J. Am. Geriatr. Soc. 55, 1932–1939.

Koyano, W., Shibata, H., Nakazato, K., Haga, H., Suyama, Y., 1991. Measurement of competence: reliability and validity of the TMIG index of competence. Arch. Gerontol. Geriatr. 13, 103–116.

Maggi, S., Minicuci, N., Langlois, J., Pavan, M., Enzi, G., Crepaldi, G., 2001. Prevalence rate of urinary incontinence in community-dwelling elderly individuals: the Veneto study. J. Gerontol. Med. Sci. 56A, M14–M18.

Maki, B.E., Holliday, P.J., Topper, A.K., 1991. Fear of falling and postural performance in the elderly. J. Gerontol. Med. Sci. 46, M123–M131.

Nelson, M.E., Layne, J.E., Bernstein, M.J., Nuernberger, A., Castaneda, C., Kaliton, D., Hausdorff, J., Judge, J.O., Buchner, D.M., Roubenoff, R., Singn, M.A.F., 2004. The effects of multidimensional home-based exercise on functional performance in elderly people. J. Gerontol. Med. Sci. 59A, 154–160.

Resnick, N.M., Beckett, L.A., Branch, L.G., Scherr, P.A., Wetle, T., 1994. Short-term variability of self report of incontinence in older persons. J. Am. Geriatr. Soc. 42, 202–207.

Shumway-Cook, A., Gruber, W., Baldwin, M., Liao, S., 1997. The effect of multidimensional exercise on balance, mobility, and fall risk in community-dwelling older adults. Phys. Ther. 77, 46–57.

Smith, L.A., Branch, L.G., Scherr, P.A., Wetle, T., Evans, D.A., Hebert, L., Taylor, J.O., 1990. Short-term variability of measures of physical function in older people. J. Am. Geriatr. Soc. 38, 993–998.

Speers, R.A., Ashton-Miller, J.A., Schultz, A.B., Alexander, N.B., 1998. Age differences in abilities to perform tandem stand and walk tasks of graded difficulty. Gait Posture 7, 207–213.

Suzuki, T., Kim, H., Yoshida, H., Ishizaki, T., 2004. Randomized controlled trial of exercise intervention for the prevention of falls in community-dwelling elderly Japanese women. J. Bone Miner. Metab. 22, 602–611.

Tennstedt, S., Howland, J., Lachman, M., Peterson, E., Kasten, L., Jette, A., 1998. A randomized, controlled trial of a group intervention to reduce fear of falling and

associated activity restriction in older adults. J. Gerontol. Psychol. Sci. 53B, P384–P392.
Tinetti, M.E., Baker, D.I., McAvay, G., Claus, E.B., Garrett, P., Gottschalk, M., Koch, M.L., Trainor, K., Horwitz, R.I., 1994. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. N. Engl. J. Med. 331, 821–827.
Tinetti, M.E., Inouye, S.K., Gill, T.M., Doucette, J.T., 1995. Shared risk factors for falls, incontinence, and functional dependence: unifying the approach to geriatric syndromes. J. Am. Med. Assoc. 273, 1348–1353.
Vellas, B.J., Wayne, S.J., Romero, L.J., Baumgartner, R.N., Garry, P.J., 1997. Fear of falling and restriction of mobility in elderly fallers. Age Ageing 26, 189–193.

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Key words：転倒予防，運動介入，身体的要素，可変因子，転倒経験者

（日老医誌　2011；48：39-41）

はじめに

転倒予防戦略を効率的に構築するためには，転倒は転倒関連危険因子（fall-related risk factor）の数と深く関連し，転倒率は危険因子の数とほぼ直線的に増加することへの考察が必要である[1]．つまり，転倒率を下げるためには危険因子の数を減らすことがポイントである（図1）．転倒の抑制策として今日まで提案されている戦略は，服薬管理，教育，環境改善，ヒッププロテクター着用，ビタミンD補充，運動などが挙げられる．

転倒予防のための運動介入の意義

転倒を予防するためには，多くの内的要■のうちの可変要因および外的要因に当てはまる因子を一つ一つ改善していく方法しかない．転倒の危険因子を総合的にまとめた先行研究によれば，転倒の相対的な危険度は筋力低下（RR＝4.4），転倒歴（RR＝3.0），歩行機能低下（RR＝2.9），バランス低下（RR＝2.9）が高く，他に視力障害，関節炎，ADL障害，認知機能障害，年齢80歳以上と関連すると指摘している[2]．なかでも，筋力，歩行，バランスなど身体的要素に関連した要因は，トレーニングや普段からの訓練によって低下を予防し，機能の強化が可能である．すなわち，高齢者の転倒原因の大きな割合を占めている身体的要因は可変因子であることに運動介入の重要な意味がある（図2）．

転倒予防を目的とした運動介入の成果については実に数多く報告されているが，その結果は必ずしも一致せず異なる成果が散見される．転倒予防効果が検証された代表的な介入は，1990年に全米8つの地域で2,400人以上を対象に3年以上行ったFICSIT研究であり[3]，その結果によれば，太極拳を中心としたバランス訓練と筋力トレーニングが最も有効な手法であることが確認されている．さらに，Campbellら[4]は，80歳以上の地域高齢者に筋力，バランス能力改善を目的とした個別処方の在宅運動プログラムを提供した場合でも，転倒予防に有効であったと報告している．一方，Suzukiら[5]は，74～89歳の地域在住高齢者を対象に，2週1回の頻度での集団指導に加えて在宅実践用の個人プログラムを提供する指導を6カ月間行った後，22カ月間の追跡期間中の累積危険度は，対照群0.545，介入群0.136であり，相対危険度は0.25であったことを報告し，監視型に在宅用運動プログラムを加える介入も転倒予防に有効であることを指摘している．一方，Dayら[6]は，70歳以上の高齢者1,090名を対象に，運動，家庭内障害物整備，視力補正の3手法による転倒予防効果を検証した．その結果によれば，単独介入では運動がRR＝0.82（95%CI＝0.70～0.97）と最も効果的であるが，運動に家庭内障害物整備，視力補正を加えるとRR＝0.67（95%CI＝0.51～0.88）に改善することを検証し，多面的支援が転倒予防により効果的であることを提案している．

しかし，Mulrowら[7]は，ADL2つ以上の障害を有するのナーシングホーム入所者194名を対象に4カ月間の運動指導後，1年間の追跡調査を行った結果，移動能力には効果が検証されたが（15.5%改善），転倒率の抑制効果は見られなかった（運動群＝79転倒，対照群＝60転倒，P＝0.11）ことを，Rubensteinら[8]は，7日以内に転倒経験を有する施設長期入所者160名を対象に行った運動指導の結果を分析したところ，介入群の転倒は9%低いものの有意差はなかった．Lordら[9]も，運動介入後に介入群と対照群との間で転倒率には差が見られなかったが（RR＝0.99，95%CI＝0.65～1.50），参加率75%以上のグループでは，転倒率が低くなる傾向が観察された．さらに，Reinschら[10]は，高齢者を対象に行った介入に

The effects of exercise for the prevention of falls
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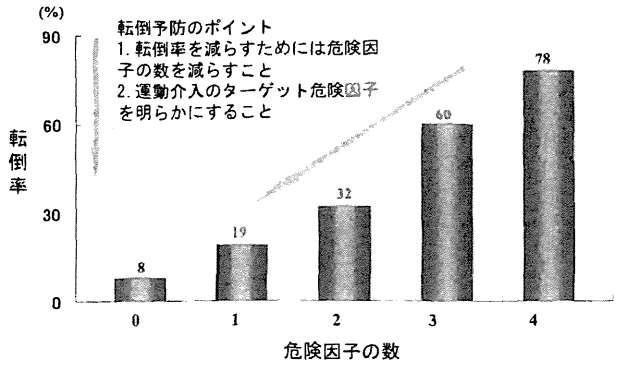

図1　転倒の危険因子の数と転倒率
文献1より改変

転倒危険因子の相対的危険度

危険因子	相対危険度
筋力低下	4.4
転倒歴	3.0
歩行機能低下	2.9
バランス低下	2.9
補助器具の使用	2.6
視力障害	2.5
関節炎	2.4
ADL障害	2.3
うつ病	2.2
認知機能障害	1.8
年齢８０歳以上	1.7

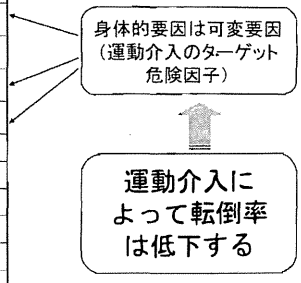

図2　転倒予防のための運動介入戦略
文献2より改変

よって転倒率，初回転倒までの時間，複数回転倒，転倒負傷のみならずバランス能力や筋力，転倒恐怖感，健康度自己評価においても効果が見られなかったことを指摘した上で，介入効果がみられなかった理由としては，運動強度が弱いことや介入頻度が少なかったことであると指摘している．

運動介入のポイント

転倒予防のための運動介入の成果について今日まで報告されている先行研究をまとめると，運動介入効果がないとの研究，身体機能の改善には有効であるが転倒率の減少効果はないとの研究，転倒率の低下のみならず転倒恐怖感の改善効果も得られるとの研究など様々である．これらの結果は，運動介入の際には対象者の諸特性を詳細に把握し，対象者特有の危険因子の改善を目的とした介入になってない場合には，効果が期待できない可能性を示唆するものである．運動介入の時の考慮すべき点は，運動種目，運動強度，運動時間，指導頻度，指導期間，指導形式などである．これらに加えてもう一つ重要なポイントがある．高齢者の転倒原因について調べた結果によれば[11]，高齢者転倒の多くは「歩行中のつまずき」によって発生することである．つまり，高齢者の歩行機能と転倒とは密接に関わり，歩行機能の改善は転倒率抑制に有効であることを示唆するものである．よって，運動介入の際には「歩行機能の改善」および「つまずき防止」を目的とした指導を取り入れるべきであると考える．歩行機能を改善するためには，大腿四頭筋，ハムストリングス，腸腰筋，下腿三頭筋，大殿筋，中殿筋などの重点的な鍛えが必要であり，すり足の改善には前脛骨筋の鍛えが必要不可欠である．次に考慮すべき点は，大腿骨頸部骨折予防である．大腿骨頸部骨折の危険因子は，側面転倒（OR＝3.9），骨密度低下（OR＝1.8），移動障害（OR＝6.4）が指摘され[12]，大腿骨頸部骨折を予防するためには側面バランス機能向上が大切であり，運動指導に当たっては，側面バランス機能の向上を目的とした運動指導が必要であるといえる．

転倒経験者の転倒予防のための運動介入

転倒経験者は転倒経験がない人に比べて身体機能が劣っているとの報告が多く，さらには再転倒の危険因子（RR＝3.0）として指摘されているが，転倒経験者に対する転倒予防戦略の成果についての検討は極めて少ないのが現状である．Skeltonら[13]は，過去1年間で3回以上転倒した65以上の在宅高齢女性81名を運動群50名，対照群31名に分け運動群に週1回，1回当たり60分間の集団指導に家庭用運動プログラムを提供しながら36週間指導したところ，運動指導期間中に発生した転倒数は運動群が対照群に比べて31％も減ったことを指摘し，運動介入は転倒経験者にも有効であると指摘している．筆者らも，2007年度大都市在住70歳以上の男女1,483名を調査し，過去1年間で1回以上転倒者241名（16.3％）に運動介入参加希望者を募集したところ，参加希望者125（51.9％），不参加者116名（48.1％）であった．参加希望者に運動介入を3カ月間実施し，1年間の追跡期間中に発生した転倒率は介入群19.6％，対照群38.3％（Z＝1.979，P＝0.048）であった（図3）[14]．以上のように，再転倒の危険性が高い転倒経験者であっても運動介入へ参加することによって，転倒率の減少効果が得られ，Seltonらの効果が追認されたと言える．

運動介入の課題

1．施設入所者に対する効果検証

施設入所者を対象とした研究結果によれば，バランス，

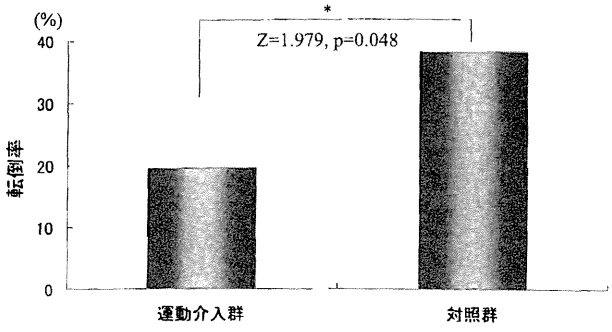

図3　転倒経験者における運動介入後1年間の転倒率
文献14より

筋力，歩行速度などの身体機能や転倒率，転倒恐怖感に改善がみられないとの報告が多く，部分的な改善効果がみられたとの報告はわずかにみられる程度である．長期施設入所者に対する運動介入の有効性については今後さらなる検討が必要といえよう．

2．介入不参加者に対する対応策の確立

前述した通り，転倒経験者でも運動介入への不参加者が48.1%と多いことが問題点である．確かに運動介入に参加し指導を受ければ転倒率は下がることが多くの研究で検証され，筆者も確かめている．しかし，運動介入不参加者の転倒率が上昇した場合には運動介入によって減少した転倒率は不参加者の上昇によって相殺されてしまい，地域全体から見たときの運動介入効果は見えにくくなることも推測される．従って，介入不参加者の特徴を詳細に把握し，不参加者への対応策の確立が最大の課題ともいえる．不参加者への対応策の一つとして「転倒予防手帳」を配布し，間接的介入効果を検討するのも1つの案であると考える．

おわりに

要介護状態になる主な原因として知られている転倒を予防するためには，転倒の可変的な因子を解消していく介入が有効である．中でも，身体的要素の減衰に基づく筋力低下，バランス機能低下，歩行機能低下は普段からの訓練によって低下を最小限に食い止め，機能強化が可能である．すなわち，高齢者の転倒原因の大きな割合を占めている身体的要因は可変因子であることに転倒予防における運動介入の位置づけである．運動介入には，集団指導型，個別処方の在宅介入型が考えられるが，いずれの介入においても，転倒予防効果を認めている．しかし，運動介入には不参加者の割合が高く，不参加者への対策の確立が課題と言える．さらには，施設入所虚弱高齢者の場合は，チームアプローチによる多面的介入によって効果が期待できると指摘されているが，運動介入の有効性については今後さらなる検討が必要である．

文　献

1) Tinetti ME, Speechley M, Ginter SF: Risk factors for falls among elderly persons living in the community. N Engl J Med 1988; 319: 1701–1707.
2) American Geriatrics Society, British Geriatrics Society, American Academy of Orthopaedic Surgeons Panel on Falls Prevention: Guideline for the prevention of falls in older persons. J Am Geriatr Soc 2001; 49: 664–672.
3) Province MA, Hadley EC, Hornbrook MC, Lipsitz LA, Miller JP, Mulrow CD, et al.: The effects of exercise on falls in elderly patients: A prepalnned meta-analysis of the FICSIT trials. JAMA 1995; 273: 1341–1347.
4) Campbell AJ, Robertson MC, Gardner MM, Norton RN, Tilyard MW, Buchner DM: Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. BMJ 1997; 315: 1065–1069.
5) Suzuki T, Kim H, Yoshida H, Ishizaki T: Randomized controlled intervention for the prevention of falls in community-dwelling elderly Japanese women. J Bone Miner Metab 2004; 22: 602–611.
6) Day L, Fildes B, Gordon I, Fitzharris M, Flamer H, Lord S: Randomized factorial trial of falls prevention among older people living in their own homes. BMJ 2002; 325: 128–131.
7) Mulrow CD, Gerety MB, Kanten D, Cornell JE, DeNino LA, Chiodo L, et al.: A randomized trial of physical rehabilitation for very frail nursing home residents. JAMA 1994; 271: 519–524.
8) Rubenstein LZ, Robbins AS, Josephson KR, Schulman BL, Osterweil D: The value of assessing falls in an elderly population: A randomized clinical trial. Ann Intern Med 1990; 113: 308–316.
9) Lord SL, Ward JA, Williams P, Strudwick M: The effect of a 12-month exercise trial on balance, strength, and falls in older women: A randomized controlled trial. J Am Geriatr Soc 1995; 43: 1198–1206.
10) Reinsch S, MacRae P, Lachenbruch PA, Tobis JS: Attempts to prevent falls and injury: A prospective community study. Gerontologist 1992; 32: 450–456.
11) 金　憲経，吉田英世，鈴木隆雄，石崎達郎，細井孝之，山本精三ほか：高齢者の転倒関連恐怖感と身体機能―転倒外来受診者について―．日老医誌　2001; 38: 805–811.
12) Greenspan SL, Myers ER, Kiel DP, Parker RA, Hayes WC, Resnick NM: Fall direction, bone mineral density, and function: Risk factors for hip fracture in frail nursing home elderly. Am J Med 1998; 104: 539–545.
13) Skelton D, Dinan S, Campbell M, Rutherford O: Tailored group exercise (falls management exercise-FaME) reduces falls in community-dwelling older frequent fallers (an RCT). Age Aging 2005; 34: 636–639.
14) 金　憲経，鈴木隆雄：転倒経験者に対する転倒予防戦略―運動中心プログラムの効果検証―．Geriat Med 2009; 47: 751–754.

Geriatr Gerontol Int 2010; 10: 280–287

ORIGINAL ARTICLE: EPIDEMIOLOGY, CLINICAL PRACTICE AND HEALTH

Effects of dehydroepiandrosterone supplementation on cognitive function and activities of daily living in older women with mild to moderate cognitive impairment

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Aim: There is little evidence that dehydroepiandrosterone (DHEA) has beneficial effects on physical and psychological functions in older women. We investigated the effect of DHEA supplementation on cognitive function and ADL in older women with cognitive impairment.

Methods: A total of 27 women aged 65–90 years (mean ± standard deviation, 83 ± 6) with mild to moderate cognitive impairment (Mini-Mental State Examination, MMSE; 10–28/30 points), receiving long-term care at a facility in Japan were enrolled. Twelve women were assigned to receive DHEA 25 mg/day p.o. for 6 months. The control group ($n = 15$) matched for age and cognitive function was followed without hormone replacement. Cognitive function was assessed by MMSE and Hasegawa Dementia Scale-Revised (HDS-R), and basic activities of daily living (ADL) by Barthel Index at baseline, 3 and 6 months. Plasma hormone levels including testosterone, DHEA, DHEA-sulfate and estradiol were also followed up.

Results: After 6 months, DHEA treatment significantly increased plasma testosterone, DHEA and DHEA-sulfate levels by 2–3-fold but not estradiol level compared to baseline. DHEA administration increased cognitive scores and maintained basic ADL score, while cognition and basic ADL deteriorated in the control group (6-month change in DHEA group vs control group; MMSE, +0.6 ± 3.2 vs −2.1 ± 2.2, $P < 0.05$; HDS-R, +2.8 ± 2.8 vs −0.3 ± 4.1, $P < 0.05$; Barthel Index, +3.7 ± 7.1 vs −2.7 ± 4.6, $P = 0.05$). Among the cognitive domains, DHEA treatment improved verbal fluency ($P < 0.05$).

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Conclusion: DHEA supplementation in older women with cognitive impairment may have beneficial effects on cognitive function and ADL. **Geriatr Gerontol Int 2010; 10: 280–287.**

Keywords: activities of daily living, cognitive function, dehydroepiandrosterone.

Introduction

Dehydroepiandrosterone (DHEA) and its sulfate (DHEA-S) are the most abundant circulating steroids mainly produced by the adrenal zona reticularis in both sexes.[1] Their circulating levels decline with advancing age,[1–4] and there has been growing public interest in DHEA supplementation to prevent age-associated physical and cognitive impairment. DHEA is considered a crucial precursor of human sex steroid biosynthesis, and to exert indirect androgenic and estrogenic effects following conversion into smaller amounts of testosterone and estradiol.[5,6] While this conversion contributes to a part of testosterone production in men, its role may be much more significant in postmenopausal women whose ovarian production of androgen and estrogen has waned. Importantly, postmenopausal women with intact ovaries continue to produce androgens; DHEA(-S), testosterone and androstenedione, while their production of estradiol is minimal.[7] However, the role of androgens in older women's health is not fully understood.

Clinical trials of the effects of estrogen replacement therapy on cognitive function have shown a lack of efficacy in postmenopausal women initiating hormone replacement therapy after the age of 65 years.[8,9] On the other hand, previous reports have suggested that DHEA may have neuroprotective effects, and the age-associated DHEA(-S) decline is associated with cognitive impairment in older women.[2,10–12] One longitudinal study observed lower DHEA-S levels in patients who subsequently developed Alzheimer's disease.[13] However, controlled trials with DHEA supplementation have failed to show beneficial effects on cognition in healthy middle-aged to older women.[14–16] In these studies, the participants were limited to those who did not have cognitive impairment; therefore, it is reasonable to hypothesize that DHEA supplementation may be effective in much older women with cognitive decline as well as lower DHEA levels.

Dehydroepiandrosterone deficiency is also considered to be involved in the development of physical frailty.[17] Clinical experience with DHEA supplementation in older women is limited, and the few clinical trials examining its effect on physical function and activity of daily living (ADL) have yielded inconsistent results.[18–20] Evidence is lacking for much older women in whom physical impairment becomes more apparent and is accompanied by an age-associated DHEA decline. In our previous study, plasma DHEA and DHEA-S levels, but not estradiol level, were independently related to higher basic ADL in older women aged 70–93 years with functional decline receiving long-term care.[21] We hypothesized that in older women, DHEA replacement could be effective for the age-related decline of physical as well as psychological function.

This study therefore examined the effect of relatively low-dose (25 mg daily) p.o. DHEA supplementation for 6 months on cognitive function and ADL in older women with cognitive impairment.

Methods

Subjects and study design

In this open, non-randomized controlled study, 27 women aged 65 years or older who attended a health service facility for the elderly (a facility that provides nursing care and rehabilitation services to elderly people with disability, Mahoroba-no-Sato, located in Nagano Prefecture, Japan) were enrolled. The participants were in a chronic stable condition and receiving Long-term Care Insurance service either for admission to the facility or day-care services. The principal inclusion criteria were mild to moderate cognitive decline; both Mini-Mental State Examination (MMSE)[22] and Hasegawa Dementia Scale-Revised (HDS-R)[23] scores were between 10 and 28. The subjects were diagnosed as having a mild cognitive impairment[24] or Alzheimer's disease according to the Diagnostic and Statistical Manual of Mental Disorders IV.[25] The participants had never been treated with hormone replacement therapy, and plasma DHEA-S concentration was less than 3.0 μmol/L. The exclusion criteria were history of stroke, extremely low ADL status (Barthel Index[26] <50), malnutrition (serum albumin <3.5 mg/dL), malignancy, acute inflammation (fever, white blood cell count >10 000/μL, or other signs of infection within 4 weeks before enrollment) and overt endocrine diseases, because these diseases may affect both plasma sex hormone levels and functions. None of the subjects were taking a cholinesterase inhibitor (donepezil hydrochloride) or glucocorticoid, opiate or hormone supplement.

Twelve women were assigned to receive DHEA capsule (25 mg/day, Athena Clinics International,

Honolulu, HI, USA) and 15 women were followed up without any additive medication. Medications that could influence cognitive function and plasma hormone levels were not changed during the study period. Outcome measures were cognitive function, ADL, plasma hormone levels, blood cell counts, blood chemical parameters and subjective adverse events. They were assessed at baseline, and after 3 and 6 months. The institutional review board of Mahoroba-no-Sato approved the study protocol, and all participants or their families gave written informed consent.

Hormone measurements

Blood samples were obtained from the participants in the morning after an overnight fast, and plasma hormone levels in addition to blood cell counts and blood chemical parameters were determined by a commercial laboratory (Health Sciences Research Institute, Yokohama, Japan). DHEA and DHEA-S were assayed using sensitive radioimmunoassays with minimum detection limits of 0.04 ng/mL (0.14 nmol/L) and 2.0 μg/dL (0.05 μmol/L), respectively. Total testosterone and estradiol were assayed using chemiluminescent immunoassays with minimum detection limits of 7 ng/dL (0.2 nmol/L) and 4 pg/mL (14.7 pmol/L), respectively. The intra-assay coefficients of variation for these measurements were less than 5%.

Cognitive function

Trained examiners administered two standardized cognitive function tests, MMSE[22] and HDS-R,[23] to assess multiple, diverse aspects of cognitive function at baseline and at the 3- and 6-month visits. Both scores range 0–30, with higher scores indicating better performance. HDS-R includes questions about the subject's age, orientation, immediate recall, serial subtraction of 7 s, reciting digits backward, recalling three words, recalling five objects and word fluency (generating names of vegetables). MMSE evaluates five aspects of cognition: (i) orientation; (ii) registration; (iii) attention and calculation; (iv) recall; and (v) comprehension of spoken language (naming objects, spoken language ability, following commands). MMSE, but not HDS-R, includes four performance tests: (i) three-stage command; (ii) reading and following a command; (iii) writing; and (iv) construction drawing). Based on the results of HDS-R and MMSE, we evaluated seven cognitive domains (points) as follows: (i) orientation (10); (ii) verbal memory (9); (iii) attention and calculation (5); (iv) visual memory (5); (v) spoken-language comprehension (9); (vi) verbal fluency (5); and (vii) performance (7).

Other functional parameters and anthropometric measures

Trained nurses and physical therapists visited the participants at the facility and performed the assessments. Basic ADL was assessed by Barthel Index,[26] mood by Geriatric Depression Scale (GDS, 15 items),[27] and ADL-related vitality by Vitality Index (10-point scale).[28] Higher GDS scores indicate a more marked self-reported depressive status, while higher Vitality Index scores indicate greater willingness.

Adverse events

Information regarding adverse events was obtained by questioning or examining the subjects. At each visit during the treatment period, all new complaints and symptoms were recorded. The safety of DHEA supplementation was assessed from the symptoms and by measuring blood chemical parameters including liver and kidney function, electrolyte levels and hematological parameters. Preexisting complaints or symptoms that increased in intensity or frequency during the treatment period also were examined.

Statistical analysis

Data were analyzed using SPSS statistical software ver. 17.0. Changes in outcome measures at 3 and 6 months were calculated by comparing the values at baseline with those at each measurement. Within each group, the significance of the change from baseline to 6 months was tested using paired Student's *t*-test. Repeated-measures ANOVA was used to test the statistical significance of the effects of DHEA versus control. Significance tests were two-sided, with an α-level of 0.05.

Results

Hormone changes and adverse effects

Characteristics and hormone levels at baseline according to treatment groups are shown in Table 1. There were no significant differences between the DHEA group and the control group in age, length of education, nutritional parameters, functional parameters and plasma hormone levels. DHEA supplementation was well tolerated, with high adherence, and there were no detectable adverse events and none of the subjects dropped out during the study. Measures of liver function, kidney function, electrolyte levels and hemoglobin level were not significantly altered by treatment with DHEA (data not shown). Body mass index remained unchanged in both groups.

Subjects in the DHEA group showed a significant increase from baseline to 3 and 6 months in levels of

Table 1 Participant characteristics at baseline

	DHEA	Control
No. of subjects	12	15
Age, years	82 ± 6 (69–90)	83 ± 6 (65–89)
Education, years	8 ± 2	8 ± 2
Nutritional parameters		
Body mass index, kg/m^2	22.0 ± 2.4 (18.8–26.4)	22.4 ± 3.2 (17.6–27.1)
Albumin, g/dL	4.4 ± 0.3 (3.7–4.9)	4.3 ± 3.2 (3.8–4.7)
Total cholesterol, mg/dL	227 ± 39 (166–294)	203 ± 22 (173–250)
Functional parameters		
MMSE	24.0 ± 4.2 (18–28)	23.4 ± 4.4 (14–28)
HDS-R	19.9 ± 5.8 (10–28)	21.7 ± 5.6 (10–28)
Barthel Index	89.6 ± 9.4 (55–100)	89.7 ± 6.4 (75–100)
Vitality Index	9.8 ± 0.6 (8–10)	9.9 ± 0.3 (9–10)
GDS	7.0 ± 4.4 (1–15)	7.0 ± 4.0 (1–13)
Hormones		
DHEA-S, μmol/L	1.8 ± 0.6 (0.7–2.4)	1.6 ± 0.8 (0.3–2.9)
DHEA, nmol/L	7.6 ± 4.7 (2.4–19.1)	6.6 ± 3.1 (2.1–11.5)
Testosterone, nmol/L	1.4 ± 0.4 (0.9–2.3)	1.3 ± 0.9 (0.2–3.8)
Estradiol, pmol/L	88 ± 52 (15–187)	70 ± 26 (45–115)

Values are shown as mean ± standard deviation (range). HDS-R, Hasegawa Dementia Scale-Revised; MMSE, Mini-Mental State Examination; GDS, Geriatric Depression Scale; DHEA-S, dehydroepiandrosterone sulfate; DHEA, dehydroepiandrosterone. There was no significant difference in each parameter between the groups.

circulating DHEA, DHEA-S and testosterone, with levels reaching approximately 2–3-fold higher than those at baseline, whereas the increase in estradiol level was not significant (Table 2). Subjects in the control group showed no significant change in hormone levels.

Changes in cognitive function and ADL

The changes in functional parameters in each group from baseline to 6 months are shown in Table 2. After 6 months, mean HDS-R score significantly improved in the DHEA group while it remained unchanged in the control group. Mean MMSE score significantly declined in the control group while it remained unchanged in the DHEA group. As a result, significant differences were found in these scores between the groups. DHEA treatment maintained Barthel Index score, whereas the score deteriorated significantly during 6 months in the control group, although the between-group difference at 6 months was not statistically significant. Regarding the components of Barthel Index, in the control group, the sum score of mobility deteriorated significantly after 6 months compared to baseline, while no significant change was observed in the sum score of self care (Table 3). Neither Vitality Index nor GDS changed significantly in both groups.

Table 4 shows the cognitive domain scores at baseline and at 3- and 6-month follow up. Among the seven cognitive domains, DHEA treatment improved verbal fluency ($P < 0.05$), resulting in a significant difference at 6 months between the groups. Verbal memory showed a non-significant trend towards improvement in the DHEA group. Performance test scores significantly declined over time in both groups. There were no differences between the groups in the scores of orientation, attention and calculation, visual memory and spoken-language comprehension.

Discussion

Daily administration of DHEA 25 mg for 6 months in elderly women with mild to moderate cognitive impairment improved cognitive function and maintained basic ADL, compared to the control group. Among the cognitive domains, DHEA significantly improved verbal fluency. At baseline, DHEA and DHEA-S levels were lower than those reported in healthy postmenopausal women in both groups,[2,4] and DHEA treatment increased DHEA, DHEA-S and testosterone levels by 2–3-fold to the mid-normal range for premenopausal

Table 2 Changes in hormone levels and functional parameters by treatment group

	DHEA				Control				*P*
	Baseline	3 months	6 months	0–6-month difference	Baseline	3 months	6 months	0–6-month difference	
Hormones									
DHEA-S, μmol/L	1.8 ± 0.6	4.5 ± 1.3*	5.6 ± 2.9*	3.8 ± 2.8	1.6 ± 0.8	1.8 ± 1.0	1.7 ± 0.8	−0.02 ± 0.4	<0.01
DHEA, nmol/L	7.6 ± 4.7	12.2 ± 4.8*	13.7 ± 7.7*	6.1 ± 8.2	6.6 ± 3.1	7.3 ± 3.7	7.4 ± 4.5	0.9 ± 2.8	0.04
Testosterone, nmol/L	1.4 ± 0.4	2.3 ± 0.7*	2.3 ± 0.8*	0.9 ± 0.8	1.4 ± 0.7	1.4 ± 0.7	1.6 ± 0.8	0.2 ± 0.5	<0.01
Estradiol, pmol/L	88 ± 52	92 ± 48	101 ± 37	13 ± 51	70 ± 26	68 ± 20	67 ± 42	−4.0 ± 38	0.17
Functional parameters									
MMSE	24.0 ± 4.2	24.1 ± 4.6	24.6 ± 4.3	0.6 ± 3.2	23.4 ± 4.4	23.1 ± 5.4	21.3 ± 5.0**	−2.1 ± 2.2	0.04
HDS-R	19.9 ± 5.8	20.5 ± 7.3	22.7 ± 6.3**	2.8 ± 2.8	21.7 ± 5.6	22.1 ± 5.6	21.3 ± 6.4	−0.3 ± 4.1	0.04
Barthel Index	89.6 ± 9.4	92.7 ± 6.5	93.3 ± 6.8	3.7 ± 7.1	89.7 ± 6.4	86.9 ± 7.2	87.0 ± 6.7*	−2.7 ± 4.6	0.04
Vitality Index	9.8 ± 0.6	9.7 ± 0.5	9.7 ± 0.7	−0.1 ± 1.0	9.9 ± 0.3	9.8 ± 0.5	9.7 ± 1.0	−0.3 ± 1.0	0.80
GDS	7.0 ± 4.4	6.2 ± 3.4	6.6 ± 3.7	−0.4 ± 1.7	7.0 ± 4.0	8.3 ± 3.9	7.5 ± 3.5	0.5 ± 3.3	0.60

Values are shown as mean ± standard deviation (range). *P*-values are for repeated-measure ANOVA over all three time points. DHEA, dehydroepiandrosterone; HDS-R, Hasegawa Dementia Scale-Revised; MMSE, Mini-Mental State Examination; GDS, Geriatric Depression Scale; DHEA-S, dehydroepiandrosterone sulfate; DHEA, dehydroepiandrosterone. **P* < 0.05 compared to baseline, ***P* < 0.01 compared to baseline.

women.[2] No detectable adverse effects were observed throughout the study.

According to the previous trials, DHEA supplementation of 50 mg or more daily does not provide beneficial effects on cognition in healthy middle-aged to elderly women without cognitive impairment.[14–16] However, in a small-scale randomized double-blind placebo-controlled study, DHEA transiently improved cognition (after 3 months) in subjects with Alzheimer's disease while the improvement was not significant at 6 months.[29] Preliminary analysis of the small number of subjects in the present study suggested that DHEA treatment was no less effective in subjects with low baseline cognitive function than those with higher cognitive function (data not shown). Whether the effects of DHEA might be influenced by baseline cognitive function should be further investigated.

It is noteworthy that the 6-month effect of donepezil hydrochloride (5 or 10 mg), the only cholinesterase inhibitor used in Japan, in patients with Alzheimer's disease ranged from no change to less than 1 point improvement in MMSE score,[29–33] which is not so different from the effect of DHEA observed in the present study.

In the present study, not only the participants' cognitive function was impaired, but baseline plasma DHEA(-S) level was also low compared to that in postmenopausal or perimenopausal women.[2,4,10] Regarding DHEA-S levels, according to a report in which healthy pre- and postmenopausal women were studied, DHEA-S levels in women aged 35–44 years and 45–55 years were as follows: 4.31 ± 2.11, 3.90 (mean ± standard deviation) and 3.42 ± 2.01 μmol/L.[2] In this study, DHEA-S was measured using chemiluminescent enzyme immunometric assay; although the measurements by this method and those by radioimmunoassay have been reported to be comparable. In our study, DHEA treatment increased DHEA-S levels to the mid-normal range for premenopausal women.[2] Also, the subjects with lower baseline DHEA-S levels showed non-significant trend towards more improvement in cognitive scores (data not shown). Thus, future studies are needed to explore whether the effects of DHEA might be influenced by baseline DHEA levels.

Because the DHEA receptor has not been identified, DHEA may act after conversion to testosterone and subsequently estradiol through estrogen receptors and androgen receptors, both of which are found in the hippocampus and frontal lobes and subserve verbal memory and working memory in women.[34,35] Further, hippocampal volume and perfusion have been shown to correlate with serum DHEA-S level in demented patients.[36,37] It has also been suggested that estrogenic and androgenic derivatives of DHEA might have different effects on cognitive functions.[38] However, the mechanism by which DHEA improves cognitive

Table 3 Changes in mobility and self-care scores in Barthel Index during the study

Domains (points)	Mean ± SD Baseline	3 months	6 months	Change (0–6 months)	*P*
Mobility (55)					
DHEA	46.9 ± 9.2	48.2 ± 6.0	49.2 ± 5.2	2.3 ± 5.4	0.01
Control	47.5 ± 5.4	46.2 ± 5.5	45.0 ± 4.3*	−3.7 ± 3.9	
Self care (45)					
DHEA	42.7 ± 6.1	44.5 ± 1.5	43.1 ± 2.5	0.4 ± 6.9	0.96
Control	41.8 ± 4.2	42.5 ± 3.4	41.2 ± 4.3	0.7 ± 3.2	

Mobility is the sum score of five domains: (i) transfer (moving from a bed to a wheelchair and back); (ii) walking on a level surface; (iii) propelling a wheel chair; (iv) ascending and descending stairs; and (v) bathing and toilet use. Self care includes feeding, grooming, dressing, bowels and bladder. *P*-values are for repeated-measure ANOVA over all three time points. $^{*}P < 0.05$ compared to baseline. SD, standard deviation.

Table 4 Changes in cognitive domain scores during study

Domains (points)	Mean ± SD Baseline	3 months	6 months	Change (0–6 months)	*P*
Orientation (10)					
DHEA	8.3 ± 1.9	8.0 ± 2.7	7.5 ± 3.0	−0.1 ± 1.2	0.28
Control	8.3 ± 1.9	8.0 ± 2.8	7.5 ± 2.9	−0.7 ± 1.7	
Verbal memory (9)					
DHEA	5.7 ± 2.1	6.5 ± 2.3	6.7 ± 2.5†	1.0 ± 1.9	0.79
Control	6.5 ± 1.7	7.5 ± 1.8	7.0 ± 1.9	0.5 ± 1.7	
Attention and calculation (5)					
DHEA	2.3 ± 1.9	2.8 ± 2.0	2.7 ± 1.8	0 ± 2.3	0.79
Control	2.0 ± 1.7	1.9 ± 1.2	1.8 ± 1.5	−0.5 ± 1.4	
Visual memory (5)					
DHEA	3.6 ± 0.9	3.6 ± 1.3	3.8 ± 1.2	0.3 ± 1.1	0.91
Control	3.6 ± 1.3	3.9 ± 0.9	3.9 ± 1.0	0.5 ± 1.1	
Language comprehension (9)					
DHEA	8.5 ± 0.8	7.8 ± 2.5	8.7 ± 0.7	0.1 ± 0.3	0.12
Control	8.5 ± 0.8	8.5 ± 0.8	8.4 ± 1.1	−0.1 ± 0.9	
Verbal fluency (5)					
DHEA	2.8 ± 3.3	2.5 ± 2.0	4.3 ± 1.1*	1.5 ± 1.7	0.01
Control	3.2 ± 1.9	3.8 ± 1.6	3.3 ± 1.9	0.1 ± 2.1	
Performance (7)					
DHEA	5.7 ± 0.7	5.5 ± 0.7	4.8 ± 0.4**	−0.8 ± 0.6	0.36
Control	5.6 ± 0.6	5.1 ± 0.6	4.5 ± 0.9**	−1.1 ± 0.8	

Change refers to score change during 0–6 months for each parameter in each treatment group. *P*-values are for repeated-measure ANOVA over all three time points. DHEA, dehydroepiandrosterone. $^{*}P < 0.05$, $^{**}P < 0.01$, $^{\dagger}P < 0.1$ vs baseline. SD, standard deviation.

function is unknown. In the present study, plasma estradiol level was not significantly increased after DHEA treatment, implying that its beneficial effects on cognition might be androgen-dependent. Unfortunately, free testosterone levels were not measured, because they were considered to be undetectable in many cases in older women. In addition, sex hormone-binding globulin (SHBG) measurement was not available; however, it has been reported that DHEA 50 mg treatment for 3 months in postmenopausal women did not significantly change SHBG levels,[39] suggesting that the change in SHBG-bound hormone levels after DHEA treatment might be minimal. Given the local aromatization of androgen to estradiol in the brain, the effect of DHEA on cognition might be indirect, complex and heterogeneous. The molecular mechanism underlying the association

between DHEA and cognitive function needs to be clarified, and active forms of testosterone and estradiol should also be examined to investigate whether they would change after DHEA administration.

In our previous study, plasma DHEA and DHEA-S levels were independently related to higher basic ADL in older women aged 70–93 years with functional decline,[21] and other reports have shown a correlation between DHEA level and muscle mass, strength and physical performance.[40,41] In the present study, DHEA treatment maintained the Barthel Index score, while the score deteriorated significantly in the control group. Regarding body composition and strength, DHEA administration in postmenopausal older women aged up to 80 years did not alter body composition, physical performance or strength.[18–20] However, in one small-scale open-label trial, DHEA treatment for 4 weeks improved ADL in three out of seven patients (both men and women) with multi-infarct dementia.[42] All these studies are preliminary, and large-scale and long-term studies are required to ascertain whether DHEA could have a beneficial effect on ADL in older women.

In the present study, no effect of DHEA on depressive mood or vitality was observed, consistent with most clinical trials in older women.[15,43,44] This might be attributable to the participants' relatively low depressive status and high vitality status, namely, ceiling effects.

The limitations of our study should be acknowledged. First, this study was neither blinded nor randomized. Second, the number of participants was too small to confirm the results. Thus, results need to be confirmed by large-scale randomized trials to exclude possible selection bias. Third, considering the sensitivity and accuracy, a standard test like the Alzheimer's Disease Assessment Scale should be used in clinical trials to ascertain the effect of DHEA. Finally, our study duration was 6 months so it does not provide any information on the effects of longer-term DHEA supplementation.

In summary, this small study showed that supplementation of DHEA 25 mg for 6 months to older women with mild to moderate cognitive impairment improved cognitive scores and maintained basic ADL. The results should be confirmed in large-scale randomized trials.

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References

1 Orentreich N, Brind L, Rizer R, Vogelman JH. Age changes and sex differences in serum dehydroepiandrosterone sulfate concentrations throughout adulthood. *J Clin Endocrinol Metab* 1984; 59: 551–555.
2 Davison S, Bell R, Donath S, Montalto J, Davis S. Androgen levels in adult females: changes with age, menopause and oophorectomy. *J Clin Endocrinol Metab* 2005; 90: 3847–3853.
3 Kaufman JM, Vermeulen A. The decline of androgen levels in elderly men and its clinical and therapeutic implications. *Endocr Rev* 2005; 26: 833–876.
4 Tannenbaum C, Barrett-Connor E, Laughlin GA, Platt RW. A longitudinal study of dehydroepiandrosterone sulphate (DHEAS) change in older men and women: the Rancho Bernardo Study. *Eur J Endocrinol* 2004; 151: 717–725.
5 Webb SJ, Geoghegan TE, Prough RA, Michael Miller KK. The biological actions of dehydroepiandrosterone involves multiple receptors. *Drug Metab Rev* 2006; 38: 89–116.
6 Labrie F, Luu-The V, Labrie C, Simard J. DHEA and its transformation into androgens and estrogens in peripheral target tissues: intracrinology. *Front Neuroendocrinol* 2001; 22: 185–212.
7 Arlt W. Androgen therapy in women. *Eur J Endocrinol* 2006; 154: 1–11.
8 Shumaker SA, Legault C, Rapp SR *et al.*, WHIMS Investigators. Estrogen plus progestin and the incidence of dementia and mild cognitive impairment in postmenopausal women: the Women's Health Initiative Memory Study: a randomized controlled trial. *JAMA* 2003; 289: 2651–2662.
9 Shumaker SA, Legault C, Kuller L *et al.* Women's Health Initiative Memory Study. Conjugated equine estrogens and incidence of probable dementia and mild cognitive impairment in postmenopausal women: Women's Health Initiative Memory Study. *JAMA* 2004; 291: 2947–2958.
10 Davis SR, Shah SM, McKenzie DP, Kulkarni J, Davison SL, Bell RJ. Dehydroepiandrosterone sulfate levels are associated with more favorable cognitive function in women. *J Clin Endocrinol Metab* 2008; 93: 801–808.
11 Goldman N, Glei DA. Sex differences in the relationship between DHEAS and health. *Exp Gerontol* 2007; 42: 979–987.
12 Valle'e M, Mayo W, Le Moal M. Role of pregnenolone, dehydroepiandrosterone and their sulfate esters on learning and memory in cognitive aging. *Brain Res Rev* 2001; 37: 301–312.
13 Hillen T, Lun A, Reischies FM, Borchelt M, Steinhagen-Thiessen E, Schaub RT. DHEA-S plasma levels and incidence of Alzheimer's disease. *Biol Psychiatry* 2000; 47: 161–163.
14 Kritz-Silverstein D, von Mühlen D, Laughlin GA, Bettencourt R. Effects of dehydroepiandrosterone supplementation on cognitive function and quality of life: the DHEA and Well-Ness (DAWN) Trial. *J Am Geriatr Soc* 2008; 56: 1292–1298.
15 Barnhart KT, Freeman E, Grisso JA *et al.* The effect of dehydroepiandrosterone supplementation to symptomatic perimenopausal women on serum endocrine profiles, lipid parameters, and health-related quality of life. *J Clin Endocrinol Metab* 1999; 84: 3896–3902.
16 Wolf OT, Kudielka BM, Hellhammer DH, Hellhammer J, Kirschbaum C. Opposing effects of DHEA replacement in

elderly subjects on declarative memory and attention after exposure to a laboratory stressor. *Psychoneuroendocrinology* 1998; **23**: 617–629.
17 Fried LP, Tangen CM, Walston J *et al.* Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; **56**: M146–M156.
18 Morales AJ, Haubrich RH, Hwang JY, Asakura H, Yen SS. The effect of six months treatment with a 100 mg daily dose of dehydroepiandrosterone (DHEA) on circulating sex steroids, body composition and muscle strength in age-advanced men and women. *Clin Endocrinol (Oxf)* 1998; **49**: 421–432.
19 Percheron G, Hogrel JY, Denot-Ledunois S *et al.* Double-blind placebo-controlled trial. Effect of 1-year oral administration of dehydroepiandrosterone to 60- to 80-year-old individuals on muscle function and cross-sectional area: a double-blind placebo-controlled trial. *Arch Intern Med* 2003; **163**: 720–727.
20 Nair KS, Rizza RA, O'Brien P *et al.* DHEA in elderly women and DHEA or testosterone in elderly men. *N Engl J Med* 2006; **355**: 1647–1659.
21 Fukai S, Akishita M, Yamada S *et al.* Association of plasma sex hormone levels with functional decline in elderly men and women. *Geriatr Gerontol Int* 2009; **9**: 282–289.
22 Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiat Res* 1975; **12**: 189–198.
23 Kato S, Shimogaki M, Onodera H. Revised Hasegawa Dementia Scale (HDS-R). *Jpn J Geriatr Psychiatr* 1991; **2**: 1339–1347.
24 Winblad B, Palmer K, Kivipelto M *et al.* Mild cognitive impairment – beyond controversies, towards a consensus: report of the International Working Group on Mild Cognitive Impairment. *J Intern Med* 2004; **256**: 240–246.
25 American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn. Washington, DC: American Psychiatric Association, 1994.
26 Mahoney FI, Barthel DW. Functional evaluation: Barthel Index. *Md State Med J* 1965; **14**: 61–65.
27 Yesavage JA. Geriatric Depression Scale. *Psychopharmacol Bull* 1988; **24**: 709–711.
28 Toba K, Nakai R, Akishita M *et al.* Vitality Index as a useful tool to assess elderly with dementia. *Geriatr Gerontol Int* 2002; **2**: 23–29.
29 Wolkowitz OM, Kramer JH, Reus VI *et al.* DHEA treatment of Alzheimer's disease: a randomized, double-blind, placebo-controlled study. *Neurology* 2003; **60**: 1071–1076.
30 Winblad B, Engedal K, Soininen H *et al.* Donepezil Nordic Study Group. A 1-year, randomized, placebo-controlled study of donepezil in patients with mild to moderate AD. *Neurology* 2001; **57**: 489–495.
31 Rogers SL, Farlow MR, Doody RS, Mohs R, Friedhoff LT. A 24-week, double-blind, placebo-controlled trial of donepezil in patients with Alzheimer's disease. Donepezil Study Group [see comments]. *Neurology* 1998; **50**: 136–145.
32 Feldman H, Gauthier S, Hecker J, Vellas B, Subbiah P, Whalen E. A 24-week, randomized, double-blind study of donepezil in moderate to severe Alzheimer's disease. *Neurology* 2001; **57**: 613–620.
33 Nozawa M, Ichimiya Y, Nozawa E *et al.* Clinical effects of high oral dose of donepezil for patients with Alzheimer's disease in Japan. *Psychogeriatrics* 2009; **9**: 50–55.
34 Janowsky JS. Thinking with your gonads: testosterone and cognition. *Trends Cogn Sci* 2006; **10**: 77–82.
35 Genazzani AR, Pluchino N, Luisi S, Luisi M. Estrogen, cognition and female ageing. *Hum Reprod Update* 2007; **13**: 175–187.
36 Magri F, Terenzi F, Ricciardi T *et al.* Association between changes in adrenal secretion and cerebral morphometric correlates in normal aging and senile dementia. *Dement Geriatr Cogn Disord* 2000; **11**: 90–99.
37 Magri F, Terenzi F, Ricciardi T *et al.* Hippocampal perfusion and pituitary-adrenal axis in Alzheimer's disease. *Neuropsychobiology* 2000; **42**: 51–57.
38 Hirshman E, Merritt P, Wang CC *et al.* Evidence that androgenic and estrogenic metabolites contribute to the effects of dehydroepiandrosterone on cognition in postmenopausal women. *Horm Behav* 2004; **45**: 144–155.
39 Stomati M, Rubino S, Spinetti A *et al.* Endocrine, neuroendocrine and behavioral effects of oral dehydroepiandrosterone sulfate supplementation in postmenopausal women. *Gynecol Endocrinol* 1999; **13**: 15–25.
40 Valenti G, Denti L, Maggio M *et al.* Effect of DHEAS on skeletal muscle over the life span: the InCHIANTI study. *J Gerontol A Biol Sci Med Sci* 2004; **59**: 466–472.
41 O'Donnell AB, Travison TG, Harris SS, Tenover JL, McKinlay JB. Testosterone, dehydroepiandrosterone, and physical performance in older men: results from the Massachusetts Male Aging Study. *J Clin Endocrinol Metab* 2006; **91**: 425–431.
42 Azuma T, Nagai Y, Saito T, Funauchi M, Matsubara T, Sakoda S. The effect of dehydroepiandrosterone sulfate administration to patients with multi-infarct dementia. *J Neurol Sci* 1999; **162**: 69–73.
43 Wolf OT, Neumann O, Hellhammer DH *et al.* Effects of a two week physiological dehydroepiandrosterone substitution on cognitive performance and well-being in healthy elderly women and men. *J Clin Endocrinol Metab* 1997; **82**: 2363–2367.
44 Arlt W, Callies F, Koehler I *et al.* Dehydroepiandrosterone supplementation in healthy men with an age-related decline of dehydroepiandrosterone secretion. *J Clin Endocrinol Metab* 2001; **86**: 4686–4692.

第51回日本老年医学会学術集会記録
〈教育講演〉

高齢者の転倒予防

神崎　恒一

Key words：要介護，転倒スコア，太極拳，個別アセスメント

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高齢者の転倒と寝たきり

高齢者は屋内外，様々な場所で転倒する危険があり，地域での転倒率は20～40％と言われている．また，転倒に伴って大腿骨頸部をはじめとして骨折が生じ，これがもとで寝たきりに陥るケースが多い（図1）．統計的にも，転倒による骨折発生頻度や転倒・骨折によって要介護に至る頻度は，高齢になるほど増加することが判明している[1]．一方，転倒によって骨折やその他の重度な外傷は免れても，再度転倒するのではないかとの不安から，意欲低下や閉じこもり状態になり，やがてADLが低下し，要介護，寝たきり状態に陥る慢性的な経過をたどるケースも多い（図1）．

転倒しやすい高齢者のスクリーニング

転倒には様々な要因がかかわるが，大きく外的要因と内的要因に分けることができる．外的要因とは屋内の段差や障害物，手すりの有無，履き物など環境要因に起因する場合を指す．一方，内的要因とは1）視力，聴力障害，姿勢変化，筋力低下など加齢に伴う虚弱性変化と，2）循環器要因（起立性低血圧など），神経系要因（パーキンソン病，認知症など），筋・骨格系要因（骨粗鬆症，変形性関節症など）などの身体要因，3）薬物によるものなどを指す．転倒にかかわる要因は多岐に渡るため，一つ一つのコンポーネントを分けて評価することは難しい．外来では，問診，診察に加えて，握力や下肢の筋力検査，片足立ち持続時間，継ぎ足歩行，Up and Goテスト，重心動揺検査などを行い，筋力，バランス能，その他を総合的に評価する．しかしながら，これらの検査は機器や時間を要する難点がある．

したがって，一般高齢者の中で転倒のハイリスク者をさがすためには，より簡易な方法を用いることが望ましい．そのために考案されたのが「転倒スコア」である．転倒スコアは自己記入式調査票であり，身体機能に関連する8項目，認知，感覚器，骨運動器に関する7項目，薬の服用1項目，環境要因に関する5項目の計21項目と，過去1年間での転倒歴を問う全22項目から成っている（図2）．大河内らは転倒スコアを用いて，地域高齢者の転倒を前向きに調査し，過去の転倒と4つの質問項目を用いることによって，感度68％，特異度70％で将来の転倒を予測できることを報告している[1]．我々は，杏林大学病院もの忘れセンターの通院患者において，転倒スコアは，片足立ち持続時間，Up and Goテスト，手伸ばし試験，握力，継ぎ足歩行の各検査と有意な相関を示し，しかも将来の転倒を予測する上で，これらの検査を代用できる可能性があることを報告した[3]．転倒ハイリスク者を見出すマススクリーニングツールとして転倒スコアは有用であると期待できる．

転倒予防のストラテジー

高齢者の要介護，寝たきりを防ぐために転倒予防が重要であることは論を待たないが，予防法が十分あるわけではない．先に記したように，転倒には様々な要因がかかわり，しかもこれらは複合して転倒発生にかかわるため，単一の要因に対する介入だけでは一般に不十分である．病院に通っていない「元気な高齢者」に対する将来の虚弱予防と，施設入所中の「虚弱高齢者」とでは，当然転倒予防対策は異なるべきである．虚弱予防として有効な運動に関して，前者に対しては筋力強化訓練など比較的強度の高い運動が有効であり，後者に対しては"転倒しないよう注意しながら"バランス運動などを行うことが効果的である．太極拳はストレッチ，バランス，筋力強化の意味では最も転倒予防にむいており，半数近くまで転倒を減らすことが報告されている（表1）．その

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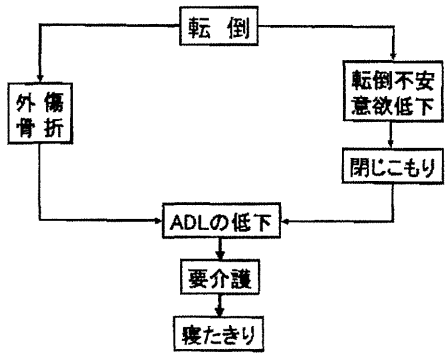

図1　転倒のもたらす影響
鈴木隆雄　老年医学 Update（文献2）より改変

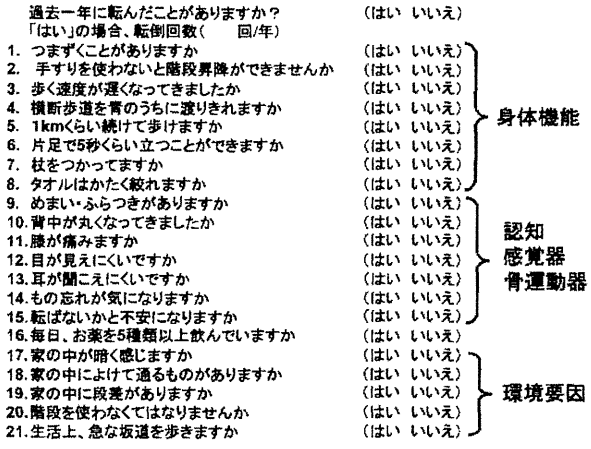

図2　転倒スコア
文献3より

ほか，屋内環境の改善，向精神病薬等の中止，総合機能評価を用いた個別指導なども転倒予防に効果を発揮している（表1）．

医師は，転倒を誘発する可能性のある不必要と思われる薬剤を中止することが重要である．一般に，高齢者は罹患疾患数の増加とともに老年症候群の数が増加し，老年症候群の増加は処方薬剤数の増加につながる．"非特異的と思われる訴え"に対して，薬が手っ取り早く使用されがちだからである．特に，睡眠薬や安定剤，抗うつ薬，抗精神病薬などの薬剤はふらつき，転倒を誘発する薬剤である．また，錐体外路症状を起こすことが知られているメトクロプラミド（プリンペラン），ドンペリドン（ナウゼリン），シサプリド（リサモールなど），スルピリド（ドグマチールなど）などの胃薬は，長期間投与されやすいので，注意が必要である．その他，利尿薬等の各種降圧薬にも転倒誘発の危険がある．いずれの薬剤も，ふらつきのある高齢者を見たら，因果関係を疑って，一つずつ減量，中止していくよう検討する．

表1　転倒骨折予防事業の科学的成績（EBM）

予防事業の種類	研究数	対象数	危険度
家屋環境改善	1	530	0.64
筋力訓練・バランス訓練	3	566	0.80
太極拳	1	200	0.51
向精神薬中止	1	93	0.34
総合機能評価・個別指導	3	1,973	0.73
ヒッププロテクター	6	3,412	0.35

施設高齢者では朝方や，夕食前後の時間帯に転倒が発生することが多い．これは排泄や更衣，整容，食事などに際して移動が多いこと，薄暗い時間であること，注意力が散漫になりやすいこと，などが個人的要因であり，また，介護，看護職員数が少なくなることも大きな原因である．このようなアセスメントに対して，シフト制を導入し，転倒が起こりやすい時間帯に人員を増やすこと，また個別ケアプランを導入することで転倒を減らすことができることが発表されている．

ただ，いかなる手段を講じても，転倒を繰り返す高齢者は存在する．この様な場合，家族に転倒が起こる危険性を十分説明し，骨折→寝たきりの可能性があることを普段からしっかり説明しておく必要がある．そのうえで，転倒しても骨折しないようヒッププロテクター等の装具を着用してもらう．しかしながら，ヒッププロテクターは着心地の悪さのため着用率が上がらないの難点がある．

最後に

転倒は様々な要因が複雑に関連しておこるため，特定の要因を明らかにし，介入することは難しい．個別に，関連要因を抽出し，その中から介入可能な要因，特に環境改善や薬物の整理に十分注意をはらうことができれば，転倒防止への効果は大きい．その際，身近にいる配偶者，家族に注意点を具体的に指示すること，それでも転倒は起こり得ることを説明しておく必要がある．転倒予防に効果がある体操もやり方を間違えれば，転倒を誘発したり，体を痛めてADLを損なう危険もあるので，常に個人に合わせて最善の方法を選択するよう配慮すべきである．

文　献

1）厚生労働省：国民生活基礎調査，2001.
2）鈴木隆雄：転倒の疫学．老年医学 Update 2004-05（日本老年医学会雑誌編集員会編），p95-105.
3）鳥羽研二，大河内二郎，高橋　泰，松林公蔵，西永正典，山田思鶴ほか：転倒リスク予測のための「転倒スコア」

の開発と妥当性の検証．日老医誌　2005; 42: 346–352.
4) Okochi J, Toba K, Takahashi T, Matsubayashi K, Nishinaga M, Takahashi R, et al.: Simple screening test for risk of falls in the elderly. Geriatr Gerontol Int 2006; 6: 223–227.
5) Kikuchi R, Kozaki K, Iwata A, Hasegawa H, Toba K: Evaluation of risk of falls in patients at memory impairment outpatient clinic. Geriatr Gerontol Int in press.
6) 辻　一郎：介護予防に対する老年学の役割．日老医誌　2004; 41: 281–283.

Fall prevention in the elderly

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Abstract

Causes of falling are multi-factorial. Although it is not easy to identify specific causes of falling, it is necessary to detect the significant causes of falling in each individual. In particular, use of medications and indoor hazards are important factors. We need to give instructions to families who live together with older persons how to avoid dangers of falling. Exercise has been proven to provide beneficial effects to prevent falling, however it is necessary to consider exactly what and how much exercise one should prescribe to elderly individual who are at high risk of falling. In other words, it is important to give best approach to prevent falling after considering the status of the elderly.

Key words: *Dependent elderly, Fall-predicting score, Tai-Chi exercise, Individual assessment*
(Nippon Ronen Igakkai Zasshi 2010; 47: 137–139)

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〈短　報〉

認知症の周辺症状と介護負担感に対する抑肝散長期投与の効果

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要　約　**目的**：認知症患者に抑肝散を6カ月以上長期投与し，認知症の周辺症状，家族の介護負担感の変化を検討する．**方法**：投与前後にDBD，ZBIを用いて評価し変化を検討した．**結果**：DBDは投与前後において有意な差を認めなかった．ZBIは有意に低下した．**結論**：抑肝散の長期投与において家族の介護負担感が軽減することが示唆された．

Key words：抑肝散，介護負担感

（日老医誌　2010；47：262–263）

緒　言

認知症の中核症状である記憶障害，見当識障害などに対し，周辺症状と位置づけられている妄想，幻覚，興奮，異常行動などの様々な精神症状や問題行動は国際老年精神医学会において認知症の行動・心理学的症候（Behavioral and Psychological Symptoms of Dementia；以下BPSDと略す）として概念や用語が統一され，近年わが国でもその対応・治療についての報告がなされている．また多くの研究によりBPSDは認知症の介護において介護負担感を増加させる最も大きな因子であることが示されており，BPSDに対する治療，対症療法は重要な意味をもつ[1]．

抑肝散（以下YGSと略す）は小児の夜泣きや精神症状に用いられており，その後認知症のBPSDに用いられるようになりその効果について多数の症例報告がされている[2]．また，Iwasakiらは4週間の抑肝散服用により基本的日常生活能力（以下基本的ADLと略す）が向上し，周辺症状が低下したと報告している[3]．今回我々は抑肝散の長期投与症例のADL，周辺症状，家族の介護負担感の変化を検討した．

対象と方法

杏林大学もの忘れセンター通院症例のなかから記憶力障害およびBPSDの訴えがみられ，YGSを投与された56例（男性21名，女性35名，平均年齢79.6±6.2歳）を対象とした．アルツハイマー型認知症21名，脳血管性認知症4名，アルツハイマー型認知症と脳血管性認知症の混合型認知症3名，前頭側頭葉変性症17名，レビー小体型認知症6名，軽度認知機能障害5名．

また，当センター通院連続症例のうち6カ月の評価期間で基本的ADL，周辺症状，認知機能，家族の介護負担感を評価できた129名（男性53名，女性80名，平均年齢78.2±7.1歳）を対照群とした．アルツハイマー型認知症66名，脳血管性認知症17名，アルツハイマー型認知症と脳血管性認知症の混合型認知症12名，前頭側頭葉変性症10名，レビー小体型認知症6名，軽度認知機能障害18名．対照群はYGS投与群に比し年齢，認知機能（Mini-Mental State examination：MMSE）の得点に有意差を認めなかった．

認知症および軽度認知機能障害の鑑別診断は医師の診察，頭部SPECT，MRI，各種心理検査の結果に基づきカンファレンスによってなされた．

抑肝散投与開始前，6カ月後に基本的ADLはBarthel Index，周辺症状Dementia Behavior Disturbace Scale（以下DBDと略す），家族の介護負担感をZarit Burden Interview日本語版（以下ZBIと略す）をもちいて評価し，後方視的に検討した．結果は平均±標準偏差で示し，各群の比較は対応のあるt検定を用いた．統計学的有意水準はすべて5%未満とした．本研究はもの忘れセンターにおける治療効果等のデータを匿名化し研究利用することを説明し文書において同意を得，杏林大学倫理委員会で承認されたものである．

The effect of YGS (Yi-Gan-San) on BPSD and care burden of dementia
Ayako Machida, Yukiko Yamada, Sayaka Kimura, Koichi Kozaki, Kenji Toba：杏林大学医学部付属病院もの忘れセンター

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