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Health Characteristics of Elderly Japanese Requiring Care at Home

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NISHIWAKI, T., NAKAMURA, K., UENO, K., FUJINO, K. and YAMAMOTO, M. *Health Characteristics of Elderly Japanese Requiring Care at Home.* Tohoku J. Exp. Med., 2005, **205** (3), 231-239 —— The number of elderly subjects requiring care is rapidly increasing, however, their health status has not been well studied. The purposes of this study were to describe the health characteristics of the elderly at home who were using long-term care insurance, and to clarify factors that influence dependence for activities of daily living (ADL). The subjects were 194 elderly people living at home, who were approved for care. The items surveyed were the demographic characteristics, care level (or level of dependence for ADL), Barthel index, grip strength, thigh muscle volume, cognitive impairment using the mini-mental state examination (MMSE), depressed mood using the geriatric depression scale (GDS-15), and serum albumin and hemoglobin levels. The grip strength (p = 0.0001), thigh muscle volume (p = 0.0030), MMSE score (p = < 0.0001) and serum albumin level (p = < 0.0001) decreased, while the GDS-15 score (p = 0.0142) increased with deteriorating care levels. The proportion of subjects not requiring assistance for the items "bathing" and "stair-climbing" in the Barthel index was markedly low in the subjects belonging to the relatively low (mild) care levels. The logistic regression analysis showed that factors associated with dependence for "bathing" and "stair-climbing" were the use of day-services, male sex, decline of grip strength, and a high GDS-15 score. In conclusion, it is important to strengthen the muscles of the upper half of the body, and to correct depressed moods for maintaining levels of ADL in the elderly requiring care at home. ——— ADL; depression; elderly; long-term care insurance; muscle strength

To cope with the increasing number of the elderly requiring care and the decreasing capacity of the family to provide care in pace with the rapidly increasing population of the elderly, the long-term care insurance system was implemented in Japan in the year 2000. By the year 2002, that is, within a span of two years, the population utilizing this long-term care insurance had nearly doubled to 2,870,000 (Statistics and Information, Minister's Secretariat, Ministry of Health, Labour and Welfare 2004). From the standpoint of the care level, the percentage of patients utilizing the

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insurance was the highest in patients requiring lower levels of care (Statistics and Information, Minister's Secretariat, Ministry of Health, Labour and Welfare 2004). The number of elderly subjects requiring care is predicted to continue to increase in the future as well, judging from number of elderly who have been registering for long-term care insurance since the initiation of the system. Strategies for preventing the need for care and preventing deterioration of the level of care are important from the viewpoints of promoting independence of the elderly themselves and of reducing the load on their families. Thus, one of the important tasks confronting the field of Public Health Sciences today is to evolve means to reduce the rapidly increasing cost of long-term care insurance in Japan.

Physical disabilities in the elderly not only influence quality of life (QOL) adversely, but are also an important risk factor of death (Tsuji et al. 1995). With regard to the health situation of the elderly requiring care, there have been some studies on the factors associated with physical disabilities in the institutionalized elderly in nursing homes (Romagnoni et al. 1999; Richardson et al. 2001; Lee and Choi 2002); the results of these studies suggest that physical factors, including fitness and muscle strength, psychological factors, including cognitive functions and moods, and the nutritional status influence the severity of disabilities or the dependence level for the activities of daily living (ADL: person's basic activity or movement in daily life, which is often used in assessing functional ability of the elderly). However, at present, 4 years after the implementation of the long-term care insurance system, the health status of the elderly requiring care at home has not been well studied. The community-dwelling elderly requiring care at home are considerably different from the institutionalized elderly in terms of socio-environmental factors and therefore, the quantity and quality of care that they receive. For this reason, the results of investigation in the institutionalized elderly cannot be directly extrapolated to the population of the elderly requiring care at home.

The present study was designed to describe the health characteristics of the elderly at home utilizing long-term care insurance from the aspects of physical health, mental health and nutritional status, and to clarify factors associated with the level of care required to propose basic strategies to prevent deterioration in the level of care required.

Subjects and Methods

Subjects

The subjects were selected from 518 elderly living at home, who were approved for care in October 2002 at Yamatomachi, Niigata Prefecture; of these, 245 subjects provided consent for participation in the survey. Fifty-one of these 245 subjects who refused consent at the time of the survey after initially consenting, or were no longer in a condition to participate in the survey, were excluded from the analysis. Finally, 194 elderly subjects were included in the survey. The survey, in which the subjects were examined medically and interviewed, was conducted between January and April 2003. For 149 of the 194 subjects who were using ambulatory care (day-service), the survey was conducted at the respective day-service facilities; for the remaining 45 subjects who were not using day-service, we visited the subjects' homes for the survey. Informed consent was obtained from all the 194 subjects and/or their family members prior to their participation in the survey. The survey was conducted with prior approval from the Ethics Committee of Niigata University School of Medicine.

Items surveyed

The items surveyed in the subjects were the demographic characteristics, care level, level of dependence for ADL, body weight, height, muscle strength, muscle volume, mental examination, and blood examination.

The primary judgment based on an assessment of the subjects' mental and physical status underlies the approval for care in the long-term care insurance system, and the care level is approved after obtaining the opinion of the physician-in-charge. The level of care is defined by the daily duration for which care is required, and has been classified into 6 levels based on this parameter: Lowest care level, i.e., mildest need for support, care required for 25 to 29 minutes daily; Care level 1, care required for 30 to 49 minutes daily; Care level 2, care required for 50 to 69 minutes daily; Care level 3, care required for 70 to 89 minutes daily; Care level 4, care required for 90 to 109 minutes daily; Care level 5, care re-

quired for longer than 110 minutes daily (Health and Welfare Statistics Association 2003).

The level of assistance required for the ADL was evaluated by using the Barthel index (Wade and Collin 1988), which consists of the following 10 items: Feeding; transfers (bed to chair and back); grooming; toilet use; bathing; mobility (on level surfaces); stairs; dressing; bowels; bladder. The level of assistance (complete assistance to independence) required for each item was scored on a 2- to 4-point scale, requirement of the maximum level of assistance being given 0 points and that of the minimum level of assistance being given 100 points (i.e., the higher the score, the lower the level of dependence). In the present study, the cutoff value between independence and dependence for the ADL in the Barthel index score was set at 60 (Sakamoto 1999); i.e., a score of 60 or more being taken to indicate independence, and a score below 60 being taken to indicate dependence. Evaluation of the level of assistance needed for the ADL was conducted by direct subject interviews. When the subjects themselves could not provide satisfactory answers, the people who were most intimate to them, i.e., staff of the day-service facilities or family members of the subjects were interviewed instead.

The body height was estimated as being twice the value of the left arm span (measured from the center of the sternal notch to the tip of the longest finger in the supine position) (Kwok and Whitelaw 1991), because the height in the standing position could scarcely be measured accurately in the subjects because of the high frequency of a round back or flexion contracture of the lower limbs. In the subjects in whom the left arm span could not be measured, the right arm span was used instead. The body weight was measured with a digital weighing scale (BWB-200S, Tanita Corporation, Tokyo) while the subjects wore only light underclothes. The body mass index (BMI) was calculated by dividing the body weight in kilograms by the square of the height in meters.

Grip strength was measured with a digital hand dynamometer (T.K.K.5401, Takei Scientific Instruments Co., Ltd., Niigata) once each for the right and left hands. Since there were several subjects in whom measurement of the grip strength failed in both the left and right hands because of paralysis, the value for either hand that was higher was adopted as the grip strength. The thigh muscle volume was measured with a bioelectrical impedance muscle analyzer (Muscle-α, Art Haven 9, Kyoto) (Miyatani et al. 2001). The muscle volume measurements obtained from subjects with paralysis, contractures, or edema of the lower limbs were regarded as unreliable.

Cognitive impairment was evaluated by the minimental state examination (MMSE) (Folstein et al. 1975), in which the lower the score, the more severe is the cognitive impairment. The presence of a depressed mood was evaluated using the geriatric depression scale (15-item version: GDS-15) (Niino et al. 1991; Herrmann et al. 1996), in which the subjects are requested to answer "Yes" or "No" to the 15 questions in the scale; a high score is indicative of a depressed mood. These psychological examinations were conducted by patient interviews by nurses who were trained and proficient in these examinations.

Blood examination was conducted in blood specimens collected in the non-fasting state. The serum albumin level and hemoglobin level were measured (BML, Inc., Tokyo) by the BCG method and SLS-HB method, respectively.

Statistical analysis

The continuous variables were expressed as means ± S.D. The GDS-15 was subjected to logarithmic transformation with the aim of obtaining a normal distribution. Differences in continuous variables between two groups were analyzed by Student's *t*-test. The tendency of each variable toward increase or decrease of the care level was tested by multiple regression analysis. Differences in the mean care levels were tested by analysis of variance and Scheffé's multiple comparison. Spearman's correlation coefficient was used to determine the correlation of the variables with the care level. The stepwise method of logistic regression analysis was conducted to select independent factors predicting independence for the ADL, by using the presence/absence of independence as an outcome variable. The SAS statistical software package (release 8.02) was used for the statistical analysis. $P < 0.05$ was defined as statistically significant.

Results

There were 135 females among the 194 subjects, showing that the proportion of female subjects was higher (69.6%). According to the care level, 23 (11.8%) subjects required mild support, 68 (35.1%) belonged to Care level 1, 47 (24.2%) belonged to Care level 2, 32 (16.5%) belonged to Care level 3, and 24 (12.4%) belonged to Care level 4. None of the subjects belonged to Care

level 5. Table 1 shows the characteristics of the subjects classified by sex. The female subjects were significantly more advanced in age. The mean values of the height, weight, grip strength, thigh muscle volume and hemoglobin level were all significantly higher in the males. There were no significant differences in the BMI, MMSE score, GDS-15 score or the serum albumin level between the male and female subjects. The past and current disease histories in the subjects are presented in Table 2.

Table 3 shows the age of the subjects and the results of the physical function tests, mental examination, and blood examination according to the care levels. The number of female subjects showed a tendency to decrease towards deteriorating care levels. The p value expressing a linear trend in the correlation of each item with the care level was adjusted for sex and age. The height, weight, grip strength, thigh muscle volume, MMSE score and serum albumin level decreased significantly, while the GDS-15 score increased significantly with deteriorating care level. The results of multiple comparisons by analysis of variance among the following combinations of care levels were significant: Support required – Care level 2, support required – Care level 3, support required – Care level 4, Care level 1 – Care level 4, and Care level 2 – Care level 4 regarding grip strength; support required – Care level 4 regarding thigh muscle volume; support required – Care level 3, support required – Care level 4, Care level 1 – Care level 3, and Care level 1 – Care level 4 regarding MMSE; support required – Care level 4 regarding GDS-15; support required – Care level 2, support required – Care level 3, support required – Care level 4, and Care level 1 – Care level 3 regarding the serum albumin level.

There was a strong correlation between the care level and the Barthel index, with a correlation coefficient (r) of -0.76 ($p < 0.0001$) in the subjects. Factors predicting overall dependence for the ADL were selected by the stepwise method of logistic regression analysis, using the cutoff Barthel index score of 60 for judging dependence or independence (Table 4). The factors predictive of overall dependence for the ADL were male sex, decline of the grip strength, high GDS-15 score, and decreased thigh muscle volume.

The proportions of the subjects not needing assistance were plotted along the y-axis for each of the 10 ADL items of the Barthel index and the care levels were plotted along the x-axis (Fig. 1); the proportion of subjects not requiring assistance for the items "bathing" and "stairs," as compared

TABLE 1. *Characteristics of the subjects classified by sex*

	Means (S.D.)	
	Female (n = 135)	Male (n = 59)
Age	84.8 (7.4)	82.2 (7.8)
Height (cm)	147.3 (6.9)	159.2 (5.9)
Weight (kg)	42.8 (9.6)	50.6 (7.5)
BMI	19.7 (4.0)	20.0 (3.1)
Grip strength (kg)	12.8 (4.6)	19.1 (6.6)
Thigh muscle volume (kg)	4.53 (1.02)	5.86 (1.10)
MMSE	22.0 (5.7)	23.1 (4.5)
GDS-15	4.4 (3.2)	5.1 (3.3)
Serum albumin (g/100 ml)	3.9 (0.4)	3.8 (0.3)
Hemoglobin (g/100 ml)	12.3 (1.9)	13.1 (1.7)

BMI, Body Mass Index; MMSE, Mini-Mental State Examination; GDS-15, Geriatric Depression Scale, 15-item version.

TABLE 2. *The past and current disease histories in the subjects*

Diseases	Number (%)
Apoplexy	61 (31.4%)
Cardiovascular diseases	25 (12.9%)
Diabetes mellitus	17 (8.8%)
Hypertension	46 (23.7%)
Pneumonia	13 (6.7%)
Other lung diseases	4 (2.1%)
Rheumatoid arthritis	5 (2.6%)
Osteoarthritis	21 (10.8%)
Osteoporosis	31 (16.0%)

TABLE 3. *Demographic, physical, mental, and biochemical characteristics according to the care level*

	Care level					
	Support required	1	2	3	4	Trend P*
	n = 23 (F 82.6%)	*n* = 68 (F 72.1%)	*n* = 47 (F 72.3%)	*n* = 32 (F 68.8%)	*n* = 24 (F 45.8%)	
Age	82.5 (6.1)	84.6 (7.2)	82.7 (9.1)	86.4 (7.0)	83.3 (7.2)	0.3298
Height (cm)	152.2 (7.5)	151.4 (8.1)	149.0 (8.6)	149.3 (9.0)	154.1 (7.2)	0.0416
Weight (kg)	49.2 (9.7)	45.4 (9.4)	45.6 (10.8)	42.1 (8.7)	44.2 (8.7)	0.0043
BMI (kg/m^2)	21.2 (3.4)	19.7 (3.7)	20.4 (4.2)	19.1 (3.4)	18.8 (3.3)	0.0613
Grip strength (kg)	18.0 (6.8)	15.4 (5.4)	14.5 (6.5)	12.4 (5.6)	12.3 (4.6)	< 0.0001
Thigh muscle volume (kg)	5.24 (1.21)	5.01 (1.13)	4.81 (1.29)	4.85 (1.34)	4.82 (1.09)	0.0030
MMSE	24.3 (2.7)	24.0 (4.2)	21.1 (5.5)	19.3 (6.8)	18.3 (6.9)	< 0.0001
GDS-15	3.1 (2.4)	4.8 (3.2)	4.3 (2.9)	4.0 (3.2)	7.5 (3.6)	0.0142
Serum albumin (g/100 ml)	4.1 (0.2)	4.0 (0.4)	3.8 (0.4)	3.7 (0.3)	3.8 (0.4)	< 0.0001
Hemoglobin (g/100 ml)	13.0 (1.7)	12.6 (1.8)	12.2 (2.1)	12.1 (1.8)	13.1 (1.6)	0.4783

F, Proportion of females; BMI, Body Mass Index; MMSE, Mini-Mental State Examination; GDS-15, Geriatric Depression Scale, 15-item version.
*Adjusted for sex and age (the variable "age" was adjusted only for sex).

TABLE 4. *Factors predicting overall dependence for the various activities of daily living (ADL) in the Barthel index (total score < 60), for "bathing" (score = 0), and for "climbing stairs" (score = 0 or 5), selected by stepwise logistic regression analysis*

Predictor variables	Odds ratio	95%CI	*p* value
Total ADL			
Male	19.7	4.4-87.7	< 0.0001
Grip strength (kg)	0.78	0.69-0.88	< 0.0001
GDS-15*	3.7	1.6-8.2	0.0017
Thigh muscle volume (kg)	0.59	0.35-0.97	0.0390
Bathing			
Day-service (0, not used; 1, used)	15.4	5.8-40.9	< 0.0001
Grip strength (kg)	0.84	0.76-0.92	0.0003
GDS-15*	3.4	1.66-7.08	0.0009
Male	6.1	1.7-22.2	0.0062
Climbing stairs			
Day-service (0, not used; 1, used)	8.6	3.3-22.3	< 0.0001
GDS-15*	2.7	1.3-5.6	0.0061
Grip strength (kg)	0.88	0.80-0.97	0.0071
Male	3.8	1.0-13.5	0.0430

*Geriatric depression scale, 15-item version, whose data are log-transformed.

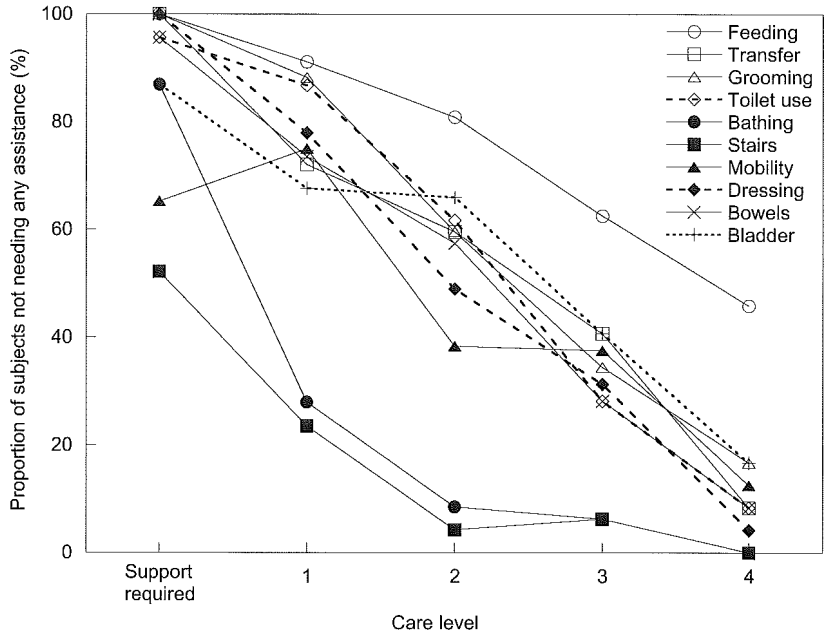

Fig. 1. Proportions of the subjects who did not need assistance for the various activities of daily living (ADL) in the Barthel index.

to other items, was markedly low in the subjects belonging to the relatively low (mild) care levels (support required – Care level 2). Therefore, factors predicting independence for "bathing" and "stairs" were selected by logistic regression analysis (Table 4). Factors significantly predictive of dependence for "bathing" and "stairs" were the use of day-services, male sex, decline of grip strength, and a high GDS-15 score.

Discussion

In the present study, there was a negative correlation between the care level and the dependence level for the ADL in the elderly living at home who required care. In the subjects who required low levels of care, for example, there was first a significant increase in the dependence level for "bathing" and "stairs". Such a pattern of loss of ADL has also been observed in other studies. Lentzner et al. (1992) investigated the care required by the elderly prior to their death, and reported that the largest number required assistance for bathing. Tsuji et al. (1994) followed up an independent elderly population longitudinally for 3 years, and reported that the frequency of dependence for bathing, among all the ADL items of the Barthel index, was the highest. Conversely, training for independence in bathing and climbing stairs was reported to be the most difficult during rehabilitation of the elderly with apoplexy (Granger 1998). Accordingly, these observations suggest that one of the most efficient measures for preventing the need for care or deterioration in the level of care is to offer training and services aimed at maintaining the ability for the various ADL (bathing, climbing stairs, etc.).

Factors predicting dependence for the ADL, based on the total Barthel index score, were sex, grip strength, depressed mood level, and thigh muscle volume, while factors predicting independence for bathing and climbing stairs were sex, non-use or use of day-services, grip strength, and depressed mood level. Thus, the factors predicting independence were slightly different from those predicting dependence as assessed by the overall score in the Barthel index. The extent of increase in the level of dependence for every item of ADL was more marked in the male subjects. One possible reason for this is that a larger number of male subjects in this study had a history of apoplexy; i.e., twice as many males as females (46.0% vs 26.8%, $p = 0.01$; data not shown in

Results section) had a history of apoplexy. The correlation between the use of day-services and the level of independence for bathing and climbing stairs may be interpreted as the elderly with a decreased level of independence being more apt to use day-services.

Grip strength has been reported to be correlated with the level of dependence for various ADL in previous studies (Rantanen et al. 1999), because grip strength is generally an indicator of systemic muscle strength, and not only of muscle strength of the upper limbs (Rantanen et al. 1994). Bathing accompanied by going-in-and-out of the bathtub and stair-climbing are considered to depend mainly on functioning of the lower limbs, however, thigh muscle volume was not selected as a significantly relevant variable in the multivariate analysis. Some possible reasons are considered: Thigh muscle volume was measured by the impedance method instead of direct measurement in the present study, which may have resulted in inaccurate assessment of the muscle strength of the lower limbs in the present study. The thigh muscle volume of the subjects requiring care may also have been inadequate for determining a statistical association, because the thigh muscle volume tended to be small, as a whole in the subjects requiring care.

Aging-induced decrease in the muscle volume is more marked in the lower limbs, particularly in the muscles on the anterior surface of the thigh, rather than in the upper limbs (Abe and Fukunaga 1995), and decreased activity has been believed to be largely involved as an extrinsic factor in this aging-induced decrease of the muscle volume (Carmeli et al. 2002). In the present subjects, the muscle strength decline in the lower limbs may have been compensated for by the muscle strength of the entire whole body (as also the upper limbs). It seems to be important, for avoidance of the need for care, to promote strengthening of the muscles of the upper limbs and the entire body, besides those of the lower limbs. The present finding supports the efficacy of various muscle strength training programs for the elderly which are being considered for introduction by local governments in Japan.

A tendency toward depression has been reported to have an adverse influence on the ADL in some previous studies (Rantanen et al. 2000; Femia et al. 2001; Wada et al. 2004). The influence has been explained by a behavioral scientific and biological mechanism as follows: Depressed mood induces decreased appetite, weight loss, and decreased activity, resulting in the decline of muscle strength (Rantanen et al. 2000). In any event, the present results suggested that not only physical factors, but also mental factors, such as depression, are important for independence for the ADL, particularly bathing and stair-climbing in the elderly requiring care.

Assessment of the relationships between the care level and each variable revealed that the body weight, grip strength, thigh muscle volume, serum albumin level, and cognitive function decreased and a tendency toward depression increased with deteriorating care level. It was inevitable that there were differences in the muscle strength and cognitive functions between care levels, because the criteria for approval of care include the level of dependence for the ADL and the severity of dementia. In particular, multiple comparisons by analysis of variance revealed distinct differences between the low care level and high care level groups in the grip strength, serum albumin level, and severity of cognitive impairment. A survey of changes in the care level in a population using long-term care insurance showed that the frequency of deterioration was the highest (30%) from "support required" (Statistics and Information, Minister's secretariat, Ministry of Health, Labour and Welfare 2004). Crimmins and Saito (1993) have also indicated that physical functions might be more easily improvable in a population in which the physical disabilities are mild and have been present only over the short term. As for prevention of deterioration of the care level, aggressive intervention from the initial stage, that is, when only mild support is required, in terms of preventing worsening of cognitive impairment and decline of muscle strength to the maximum extent as possible may lead to delay in deterioration of the care level.

The serum albumin level also decreased with

deteriorating care level. It has also been suggested that weight loss in the elderly is mainly due to a decrease in the volume of non-adipose tissues, including skeletal muscles, rather than a decrease in the amount of adipose tissue (Schneider et al. 2002), and that there is significant correlation between the decrease in serum albumin level and decrease in the skeletal muscle volume (Baumgartner et al. 1996). Fiatarone et al. (1994) demonstrated the efficiency of muscle strength training (exercise training) and nutritional supplementation for improvement of physical functions in the elderly. Based on these studies, nutrition is considered to be closely involved in the muscle strength in the elderly, and maintenance of adequate nutrition also seems to be extremely important for improvement of independence for the ADL. In Japan, local government has recently launched a project to explore an effective health program for the elderly by conducting practical interventions involving muscle strength training, nutrition improvement, or both (Ministry of Health, Labour, and Wealfare 2004). This kind of project should be promoted to develop strategies to avoid the need for care in communities.

There are some limitations to our present study. One is that the study was a cross-sectional study. The correlations between deteriorating care level and the various factors were observed in a cross-sectional way. Studies using a longitudinal study design are needed to confirm the present results. Another limitation is the possibility of a selection bias, because less than half of the total population using long-term care insurance were registered for the present study. Elderly subjects with severe dementia were excluded from the study, and the proportion of the elderly using day-service that were registered for the study was higher than that of the population that did not use day-service.

In conclusion, the elderly at home who show increased dependence regarding bathing and climbing stairs should begin to require care, and improvement in and maintenance of these activities (items) may contribute to the prevention of deterioration of the care level. It is important to strengthen the muscles of the entire body, including those of the upper half of the body, and to correct depressed moods in order to improve and maintain these activities. Cohort studies and interventional studies are needed in the future to endorse the findings of this study.

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