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Effects of exercise frequency on functional fitness in older adult women

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Abstract

This study evaluated the effects of exercise frequency on functional fitness in older women participating in a 12-week exercise program. Participants (67.8 ± 4.6 years) were divided into three different exercise groups (I, II, and III; $n = 34$) and a control group (Group C; $n = 11$). Group I participated in a 90-min exercise program once a week, for 12 weeks, while Group II attended it twice a week, and Group III attended three times a week. The exercise program consisted of a 10-min warm-up, 20 min of walking, 30 min of recreational activities, 20 min of resistance training, and a 10-min cool-down. The following items were measured before and after the program: muscular strength, muscular endurance, dynamic balance, coordination, and cardiorespiratory fitness (6-min walking distance). Comparisons of baseline and post-intervention measures showed significantly greater improvements in body weight, coordination, and cardiorespiratory fitness for Group III compared to the other groups ($p < 0.05$). In addition, the greatest improvements in body fat, muscular endurance, and dynamic balance were also observed in Group III ($p < 0.05$). However, no significant differences were found in muscular strength. Older women who participate in an exercise program three times a week gain greater functional fitness benefits than those who exercise less frequently. In order to improve functional fitness in older women, an exercise frequency of at least three times each week should be recommended.

Keywords: Exercise of older women; Functional fitness; Frequency of exercise

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1. Introduction

Advancing age is generally accompanied by a progressive decline in physical activity (Evans and Meredith, 1989). Age-related decline has been documented for functional fitness; including muscular strength, flexibility, balance, agility, gait velocity, and cardiorespiratory fitness (Raab et al., 1988; Rikli and Edwards, 1991). For years, performance decline in these areas was thought to be a normal and necessary consequence of aging. Previous studies, however, indicate that decline relates more to lifelong physical activity levels than to age. Physically active older women, for instance, were found to have performance patterns of flexibility, balance, and agility more similar to younger participants than to their older inactive pairs (Rikli and Busch, 1986). Based on these findings, interest in examining the relationship between musculoskeletal health and exercise in older adults has emerged (Vuori, 1995). Especially for women, muscle mass, muscular strength, muscular endurance, and cardiorespiratory fitness are important components of functional fitness; they are also the major causes of limited mobility and activity (Rantanen et al., 1994). Therefore, it is important for older women to exercise regularly to maintain and to recover functional fitness.

There are many reports which indicate that exercise intervention for older women produces an improvement in functional fitness. Nichols et al. (1995) have reported significant strength improvement in men and women over 60 who followed a strength training program twice a week for 12 weeks. Brown and Holloszy (1993) have reported significant differences in the flexibility of older participants who followed a training program twice a week for 12 weeks, and Wolfson et al. (1996) state that elderly individuals participating in a training program three times a week can significantly improve their dynamic balance after 12 weeks. According to these studies, exercise more than twice a week seems to improve functional fitness. However, only a few attempts have so far been made to establish how frequently older adults should exercise in order to improve their functional fitness.

Our aim was to evaluate the effects of exercise frequency on body composition and functional fitness in older women participating in a 12-week exercise program, to identify the minimum frequency per week required to produce significant results for the selected items.

2. Subjects and methods

2.1. Participants

Participants in this study were 45 healthy sedentary women (67.8 ± 4.6 years of age) living independently. Participants were permanent residents in Ibaraki prefecture who had not been involved in any physical activity for at least 6 months before the exercise program began. The study was approved by the Institutional Review Board of University of Tsukuba. All patients signed the informed consent form. According to their place of residence, they were divided into three different exercise groups (Group I; $n = 10$, Group II;

$n = 10$, and Group III: $n = 14$) and a control group (Group C: $n = 11$). Group I participated in a 90-min exercise program once a week, for 12 weeks, while Group II attended the program twice a week, and Group III attended three times a week.

2.2. Anthropometry and body composition

Body height was measured to the nearest 0.1 cm. Weight was assessed to the nearest 0.1 kg using a beam scale. Body fat was determined using bioelectrical impedance (SS-103) (Sekisui Chemical Co., Ltd.). Body mass index (BMI) was calculated by dividing weight (kg) by height (m) squared (kg/m^2).

2.3. Functional fitness test items

Items were selected to address comprehensively each area of the instrumental activities of daily living (IADL) for older adults (Osness, 1989; Duncan et al., 1990; Kim and Tanaka, 1995; Shigematsu and Tanaka, 2000). IADL are related to complex physical abilities, such as light house-cleaning activities, preparing dinner, making beds, washing and ironing clothes, shopping, and walking (Spirduso, 1995). In this study, we selected six items, which are high in relation to IADL. The six functional fitness test items, the physical elements, and the methods used are as follows:

(i) Hand gripping (muscular strength): the subject was instructed to hold a hand-grip dynamometer (Takei Industrial, Grip-D) in the dominant hand, and to try gripping it with maximum effort while keeping the dominant hand away from the body. Performance was recorded in units of 0.1 kg.
(ii) Arm curl (muscular endurance): the subject was instructed to sit on a chair and then use the dominant hand to bring a weight (2.0 kg) up and down (flex and extend the biceps) as many times as possible in 30 s. Performance was assessed on the frequency of repetitions.
(iii) Sit-and-stand (muscular endurance): the subject was instructed to sit on a chair, back straight, feet shoulder-width apart and flat on the floor, and arms crossed at the wrists and held against the chest. On the signal, the subject rises to a full stand and then returns to a fully seated position. The subject is encouraged to complete as many full stands as possible within 30 s.
(iv) Reaching arms forward in a standing position (functional reach) (dynamic balance): the subject was asked to stand and then raise both arms to shoulder level. Performance was assessed on the maximal distance the subject could reach forward beyond her own arm's length, while the heels remained touching the ground.
(v) Walking around two cones (coordination): the subject was asked to sit in a chair located between two cones, which were placed 1.8 m on either side of and 1.5 m behind the chair. On the signal, the subject rose from the chair, walked to her right going to the inside and around the back of the cone (counterclockwise), returned to a fully seated position on the chair, walked around the other cone (clockwise), and returned to a fully seated position. One trial consisted of two complete circuits. Performance time was recorded in units of 0.1 s.

(vi) Six-minute walk distance (cardiorespiratory fitness): the test involves assessing the maximum distance that can be walked in 6 min along a 50 m course marked out in 5 m segments. The subject is instructed to walk as fast as possible (without running) around the course as many times as she can in 6 min. The score is the total number of meters walked in 6 min, to the nearest 5 m. Test administrator records the nearest 5 m mark.

The tests were all checked for reliability and validity during fitness demonstration with the elderly (Shigematsu et al., 1998; Jones et al., 1999; Enright, 2003).

2.4. The exercise program

The three experimental groups participated in the 12-week intervention program once, twice, or three times a week (Groups I, II, and III, respectively). Each exercise session lasted approximately 90 min. The exercise program consisted of a 10-min warm-up, 20 min of walking, 30 min of recreational activities, 20 min of resistance training, and a 10-min cool-down. The intensity of the walking session was approximately 13 of the rating of perceived exertion (RPE) during the session. In recreational activities, we demonstrated elements of balance, agility, and coordination using a rubber ball (diameter 10–20 cm), a Slomo® Ball (diameter 20–40 cm), a soft valley ball (diameter 30–50 cm), and a Gymnic® ball (diameter 60–80 cm). In resistance training, we demonstrated push ups, leg squats, sit ups, and back extensions using self-weight or a Thera-Band® tube. During the resistance training sessions, the participants performed three sets of 10 repetitions with a 30-s rest between sets. The control group (Group C) did not follow any exercise program.

2.5. Statistical analysis

Statistical analyses of the data began with calculations of the arithmetic means and standard deviations (±S.D.). The effects of training were assessed using the two-way analysis of variance (ANOVA) with repeated measures. If the significance of the interaction of group by time in ANOVA with repeated measures had a $p < 0.05$, we analyzed the differences between the groups at the baseline and the change rate before and after intervention using the one-way ANOVA. If there was a difference in change rate between groups on specific parameters at the baseline, the parameter was used as a covariate in the analysis. Post-hoc tests were carried out using the Bonferroni correction. $p < 0.05$ are considered to indicate statistical significance. Statistical analysis was performed with the Scientific Package of Sciences (SPSS) Version 11.0J for Windows PC.

3. Results

The physical activity levels of the subjects at the baseline are presented in Table 1. Significant differences were found in body fat between Groups III and C, and between Groups I and C. There was no significant difference in other baseline values of physical characteristics among the groups.

Table 1
Baseline physical characteristics of the study subjects

Variable	Group C ($n = 11$)	Group I ($n = 10$)	Group II ($n = 10$)	Group III ($n = 14$)	p-value
Age (year)	69.0 ± 4.9	65.1 ± 4.3	67.5 ± 3.6	69.1 ± 4.9	0.156
Height (cm)	148.1 ± 5.2	151.0 ± 4.4	150.4 ± 4.4	147.8 ± 5.2	0.292
Body weight (kg)	58.7 ± 8.2	56.8 ± 6.6	56.5 ± 4.7	52.2 ± 9.0	0.185
Body fat (%)	35.8 ± 3.2	31.9 ± 3.1	34.0 ± 2.6	32.2 ± 4.3	0.040*
BMI (kg m^{-2})	26.7 ± 2.6	24.9 ± 2.4	25.0 ± 1.6	23.9 ± 3.7	0.118

Values are presented as mean ± S.D.
* Significant difference between Group III and Group C ($p < 0.05$), and between Group I and Group C ($p < 0.05$).

Interaction of group by time was found for body weight, body fat, and BMI. There was a significant difference in the effect of time in body fat between Group III and Group C ($p < 0.05$). There was a significant difference in the effect of time in BMI between Group III and Group C ($p < 0.05$) (Table 2). The mean percentage changes in body weight and BMI in Groups C, I, II, and III were +1.1%, +0.4%, +0.1%, and −2.8%, respectively. The mean percentage changes in body fat were +2.0%, +0.5%, −0.3%, and −2.4% (Fig. 1).

Interaction of group by time was found for grip strength, arm curl, sit-and-stand, functional reach, walking around two cones and 6-min walk distance. There was a significant difference in the effect of time between Group II and Group C ($p < 0.05$), and Group I and Group C ($p < 0.05$). There was a significant difference in the effect of time between Group III and Group II ($p < 0.05$), and Group I ($p < 0.05$), and between Group II and Group C ($p < 0.05$), and between Group I and Group C ($p < 0.05$) (Table 3).

The mean percentage changes in grip strength in Groups C, I, II, and III were −1.1%, −1.4%, −2.1%, and +1.4%, respectively. The mean percentage changes in arm curl were −0.2%, −3.9%, −0.9%, and +7.5%. The mean percentage changes in sit-and-stand were −6.0%, −1.5%, −2.5%, and +4.4%. The mean percentage changes in functional reach were −1.9%, −3.0%, −4.5%, and +9.6%. The mean percentage changes in walking around

Table 2
Physical characteristics of the study groups before and after 12-week intervention

Variable	Group C ($n = 11$)	Group I ($n = 10$)	Group II ($n = 10$)	Group III ($n = 14$)	Two-way ANOVA			Post-hoc test
					Group	Time	Interaction	
Body weight (kg)								
Baseline	58.7 ± 8.2	56.8 ± 6.6	56.5 ± 4.7	52.2 ± 9.0	0.07	0.32	$p < 0.05$	ns
12 weeks	59.4 ± 8.4	57.0 ± 6.4	56.6 ± 4.8	50.5 ± 7.4				
Body fat (%)								
Baseline	35.8 ± 3.2	31.9 ± 3.1	34.0 ± 2.6	32.2 ± 4.3	$p < 0.05$	0.94	$p < 0.05$	C < III
12 weeks	36.5 ± 3.3	32.1 ± 3.0	34.0 ± 2.7	31.5 ± 4.7				
BMI (kg m^{-2})								
Baseline	27.0 ± 2.8	24.9 ± 2.4	25.0 ± 1.6	23.9 ± 3.7	$p < 0.05$	0.34	$p < 0.05$	C < III
12 weeks	26.7 ± 2.6	25.0 ± 2.3	25.0 ± 1.6	23.1 ± 3.1				

Values are presented as mean ± S.D.

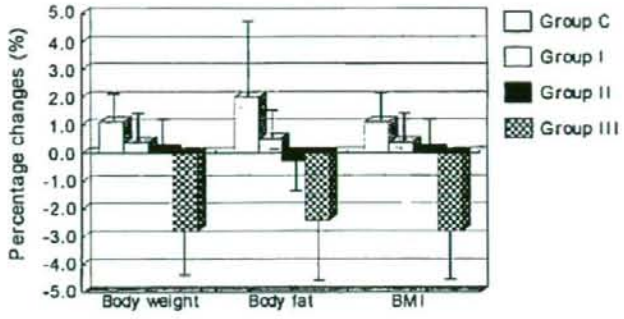

Fig. 1. Percentage changes in body weight and body fat after 12-week intervention. Significant difference in percentage changes between Group III and Group C, Group I, and Group II ($p < 0.05$) in body weight and BMI. Significant difference in percentage changes between Group III and Group C ($p < 0.05$) in body fat.

two cones were +2.5%, +2.9%, +2.3%, and −6.2%. The mean percentage changes in 6 min walk distance were −2.2%, −0.7%, −0.7%, and +4.1% (Fig. 2).

4. Discussion

In this study, we attempted to examine how frequently exercise is necessary for improving body composition and functional fitness in sedentary older women.

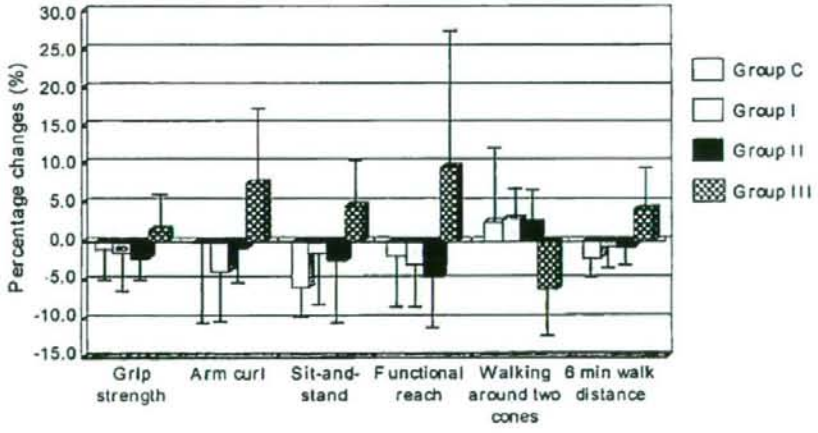

Fig. 2. Percentage changes in physical fitness after 12-week intervention. Significant difference in percentage changes between Group III and Group I ($p < 0.05$) in Arm curl. Significant difference in percentage changes between Group III and Group C ($p < 0.05$) in Sit-and-stand. Significant difference in percentage changes between Group III and Group I, and Group II ($p < 0.05$) in functional reach. Significant difference in percentage changes between Group III and Group C, Group I, and Group II ($p < 0.05$) in walking around two cones and 6 min walk distance.

Table 3
Functional fitness of the study groups before and after 12-week intervention

Variable	Group C ($n = 11$)	Group I ($n = 10$)	Group II ($n = 10$)	Group III ($n = 14$)	Two-way ANOVA			Post-hoc test
					Group	Time	Interaction	
Grip strength (kg)								
Baseline	26.3 ± 2.9	27.5 ± 6.2	25.7 ± 1.6	23.6 ± 3.8	0.19	0.16	0.28	–
12 weeks	25.9 ± 2.7	27.2 ± 6.6	25.2 ± 1.7	23.9 ± 3.8				
Arm curl (cm)								
Baseline	23.6 ± 3.6	24.4 ± 4.0	22.8 ± 3.0	21.6 ± 2.2	0.61	0.80	$p < 0.05$	ns
12 weeks	23.5 ± 4.1	23.5 ± 4.2	22.5 ± 2.4	23.1 ± 2.7				
Sit-and-stand (rep)								
Baseline	16.3 ± 3.1	17.7 ± 2.3	16.8 ± 1.8	17.7 ± 2.1	0.09	0.13	$p < 0.05$	ns
12 weeks	15.3 ± 2.9	17.4 ± 2.3	16.4 ± 2.4	18.4 ± 2.0				
Functional reach (cm)								
Baseline	26.7 ± 4.3	34.6 ± 4.7	33.3 ± 2.2	28.6 ± 2.9	$p < 0.05$	0.74	$p < 0.05$	C < I, II
12 weeks	26.1 ± 3.6	33.5 ± 4.6	31.7 ± 1.9	31.4 ± 5.3				
Walking around two cones (s)								
Baseline	24.8 ± 4.9	18.4 ± 3.1	17.9 ± 2.2	24.8 ± 3.6	$p < 0.05$	0.98	$p < 0.05$	C < I, II; I, II < III
12 weeks	25.4 ± 5.7	18.9 ± 3.0	18.3 ± 2.1	23.3 ± 3.8				
6 min walk distance (m)								
Baseline	530.9 ± 47.3	571.0 ± 51.5	538.0 ± 43.2	520.4 ± 59.1	0.19	0.99	$p < 0.05$	ns
12 weeks	519.1 ± 45.7	566.5 ± 45.8	534.0 ± 41.6	540.7 ± 56.4				

Values are presented as mean ± S.D.

In general, exercise training has a positive effect on body composition. Also, it is reported that aerobic and resistance training decrease body fat. Owens et al. (1999) described that aerobic training (157 beat/min, 40 min/set, five times a week, 4 months in the obese) decreased body fat. Poehlman et al. (2000) reported that resistance training (80% of 1RM, three times a week, 6 months, middle-aged women) increased FFM but not body fat. Moreover, Park et al. (2003) described that combined training (aerobic + resistance, three times a week) decreased body weight and body fat. As with those previous studies, they reported that aerobic or resistance training for more than three times a week improved body composition. Kallinen et al. (2002) also found similar results with older women. In our study, the greatest improvements in body weight, body fat, and BMI were observed in the Group III. Our intervention did not produce the improvement in body composition as reported in the previous research. However, the effect was seen in body composition for exercise done three times a week, including recreational activities. For this reason, energy expenditure was increased overall, we demonstrated exercise for 90 min, longer than the exercise duration reported by previous studies (40–60 min) (Moore, 2000; Zhang et al., 2003). Based on these results, it is suggested that older women should engage in exercise over a long period of time in order to improve body composition.

As well as improving body composition, it is important for older adults to maintain functional fitness. Voorrips et al. (1993) reported on functional fitness in three groups (sedentary, moderately active, and highly active). They showed that moderate activity is of greater value than a sedentary situation, and that higher-intensity activity is more valuable than moderate-intensity activity for body weight, BMI, flexibility, and endurance (walking). Van Heuvelen et al. (2000) reported that walking endurance, grip strength, manipulation and dynamic balance contributed significantly to the prediction of disability for older adults. Gregg et al. (2003) also concluded that increasing and maintaining physical activity levels could lengthen life for older women. This can be seen from the results of moderately active and highly active groups having continued physical activity over many years. Additionally, Bovens et al. (1993) described that high numbers of this physically fit and healthy population had fewer risk factors for cardiovascular disease than less active populations. Dargent-Molina et al. (1996) also reported that maintaining functional fitness prevented hip fracture from falls. Therefore, regular exercise, especially over a long period of time, is important for older people in order to improve functional fitness.

Various researchers have found significant improvements in a number of functional fitness areas after exercise intervention, e.g., in strength (Nichols et al., 1993), in flexibility (Rikli and Edwards, 1991), in dynamic balance (Load et al., 1996; Shumway-Cook et al., 1997), in muscular coordination (Rikli and Edwards, 1991; Bouchard and Shephard, 1994). It is thought that exercise programs certainly improve the functional fitness practiced in these reports. However, for many people functional fitness declines in older adulthood; it is not enough to improve a single function through an exercise program (American College of Sports Medicine, 1998). We made the evaluation that three exercise programs for overall physical strength will bring about an improvement in older women. It is important to examine how often the exercise is necessary, because many of the previous studies do not refer to frequency of exercise. That is why we intervened at three separate levels of the frequency of exercise program, and looked for improvement of overall functional fitness.

Regarding frequency of exercise intervention, Stiggelbout et al. (2004) evaluated the effects of an exercise program on the functional fitness of independently living older adults. According to the study, although the authors concluded that the exercise program was well suited to healthy inactive older adults, twice-a-week participation without additional regular physical activity did not improve functional fitness. Also, Puggaard (2003) reported that exercise intervention twice a week was not sufficient. Our study provided similar results and it seems logical to conclude that participation in exercise programs only twice a week is not sufficient to improve functional fitness. This indicates that older individuals should endeavor to participate in exercise at least three times a week. As a matter of fact, we assumed that a once-a-week exercise program would have an effect on overall functional fitness in older participants. However, the results suggest that it is necessary to exercise at least three times a week to improve overall functional fitness.

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運動実践の頻度別にみた高齢者の特徴と運動継続に向けた課題

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運動実践の頻度別にみた高齢者の特徴と運動継続に向けた課題

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Characteristics and challenges of continued exercise for older adults with reference to exercise frequency

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Abstract

To encourage older adults to participate in exercise, it is important for self-governing bodies to divide them into subgroups according to exercise habit and to determine facts such as what they think about exercise and what type of programs would help them most. In Japan, however, few such schemes have been reported. This study aimed to clarify the process of ascertaining the characteristics of older adults and to establish a challenging means of encouraging continued exercise. The eligible study population was all residents aged 65-69 years living in Isobe town, Mie Prefecture, Japan (n = 675), 460 (68.1%) responded to our questionnaire during a two-month period (November-December) in 2003. The respondents were divided into subgroups according to exercise frequency: those exercising twice a week or more (21.1%, Group A), once a week (6.3%, Group B), once or twice a month (7.6%, Group C), and no exercise (65.0%, Group D). Group A exercised because they believed they became healthier or achieved an improved fitness level. Group B undertook exercise as they regarded rapport as important, i.e. making friends at group exercise classes. To the question "Why don't you exercise?" Group C noted the lack of an exercise companion, and Group D noted low motivation. From the responses to "What type of approaches do you look for so that you might start exercise?" Group C suggested approaches such as an invitation to join an exercise class, or an introduction to an exercise instructor, and Group D suggested an exercise program that they could per-

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form at home. Based on these results, a challenge for each group was established: to maintain the exercise frequency (Group A), to increase awareness of the effects of exercise (Group B), to participate more in group exercise sessions (Group C), and to experience an easy-to-use home exercise program (Group D). Future research is required to ascertain the effects of such challenges on exercise habit in older adults.

Key words : health, physical independence, functional fitness, exercise habit, health promotion

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キーワード：健康，自立，体力，運動習慣，健康増進

I 目　　的

運動は高齢者の健康や身体的自立の保持・向上に有用であるとされている（American College of Sports Medicine Position Stand, 1990）．近年では日常生活での身体活動量の増加を重視するCenters for Disease Control and Prevention and American College of Sports Medicine（以下「CDC/ACSM」と略す）の勧告（Pate et al., 1995）が注目されている．そこでは日常生活での身体活動量を増加させることで，健康に大きな効果がもたらされるとしている．「健康日本21」の高齢者を対象とした身体活動・運動カテゴリでも日常生活における歩数の増加が目標の一つに掲げられており，そのことが自立度低下の抑制につながるとしている（健康・体力づくり事業財団，2000）．また，American Heart Association（以下「AHA」と略す）の勧告（Thompson et al., 2003）でも，日常の身体活動量を増加させることで全身持久性や筋力などの体力の増加，冠動脈疾患リスクの低減といった効果があるとしている．

総務省によると高齢者の5―6割が「1年間にスポーツをおこなったことがある」と回答しているものの（総務省統計局，2002a），その実践時間は平均で13分/週と少ない（総務省統計局，2002b）．運動習慣のない者に向けて急に実践を促すことは困難であるため，前述したような身体活動量の増加を目標とする勧告は運動開始のきっかけとして有効であると考えられる．

しかしその一方で，日常生活での身体活動量を増加させるだけでは体力を向上させるには不十分とする報告もある．Brach et al.（2004）によると，日常生活での身体活動量を増やすことは何もしないことよりも体力低下を招きにくいが，定期的な運動の方が大きな効果をもたらすとしている．このような勧告の違いは，CDC/ACSM（Pate et al., 1995）やAHA（Thompson et al., 2003）が身体活動量の少ない者や体力水準の低い者を中心に焦点をあてているのに対し，Branch et al.（2004）はそれよりも身体活動量が多く，体力水準の高い者を対象にしているということで説明できる．そのため，ある程度の身体活動量をすでに有している"元気"な高齢者は，日常生活に対して付加的に運動を実践することで高い体力水準を長期にわたって確保することができるといえよう．実際，CDC/ACSMの勧告（Pate et al., 1995）では1日延べ30分以上の身体活動のみを強調していると捉えられることが多いが，健康や身体的自立度の確保といった観点から水泳やサイクリング，テニスなどの他種目も勧めているし，筋力や柔軟性の運動も見過ごすわけにはいかないとしている．

高齢化がますます進むなか，要介護者への取り組みの充実が求められている一方で，元気な高齢者の体力水準の保持・向上につながる取り組みも必要になってきている．高齢化の進んでいる自治体では，これら両者に取り組むことが重要である．

自治体は独自の考える計画や健康目標値を住民に提示するものの，運動実践につながる要因（条件）を考慮しないために奏功しないこともある（長ヶ原，2005）．そのためMarcus and Forsyth（2003）はテーラードプログラム（tailored program，つまり個別プログラム）に対して，ターゲットプログラム（targeted program，つまりターゲットを絞った対象集団プログラム）といわれる「どのような運動状況の人が多いかを把握し，彼らに共通した特徴を探り，また何を共通に望んでいるかを把握した上で，その集団向けのプログラムを作成する」ことを勧めている．例えば，ある集団には対面式よりも印刷物などのメディアを通じた非対面式のアプローチの方が運動実践への強力な誘因になるという報告があり（Dishman and Buckworth，1996），このような知見を活用することで，より多くの住民を対象とした健康つくりを推進できるようになる．しかし，どのように実施していけばよいかというプロセスを具体的に示した例は限られている．そこで本研究では，高齢者を運動の実践状況で分類し，それぞれの特徴を把握した上で，取りかかるべき課題を設定するというプロセスを提示することとした．

II 方　　法

1．対象地域と対象者の選定

三重県志摩郡磯部町（現・志摩市磯部町）は県中央部にあり，漁業と農業の盛んな町である．この町は三重県下69市町村のうち，高齢化率が30位（25.7％），高齢者の単身もしくは高齢者のみの夫婦の世帯数の割合が25位（6.4％）と，高齢化に関する指標から平均的な自治体とみなされたこと，かつ保健センターや老人クラブ連合会，いきいきネットワーク（社会福祉協議会，民生委員，健康つくり委員，福祉課，区会長で構成）の協力を得られたことから，同町を本研究の対象地域とした．

次に，健康・体力つくりの専門家および筆者らで協議し，対象年齢層を65―69歳とした．この年齢層を限定した理由は，定職を持っていないことから自身のために時間を利用できる人が多く，かつ，自身の運動に対する態度やライフスタイルを後期高齢者に比べて容易に変容できるであろうと考えたためである．その後，磯部町の協力を得て，2004年3月31日の時点における65―69歳の者全員を住民基本情報より抽出した（施設入居者を除いた男性344名，女性331名，計675名）．

2．倫理的配慮

本研究を開始するにあたり，筑波大学人間総合科学研究科スポーツ医学専攻の倫理委員会による審議にて倫理的問題の生じないことを確認し，調査進行の承認を得た．その後，対象者に研究目的を伝えるとともに，回答された情報を研究以外の目的で使用しないことを伝え，承諾を得た．疑問点のある場合には直接説明するようにした．

3．調査方法

1）質問紙

質問紙では，運動を「健康つくりや楽しみのために意図的におこなう運動（スポーツを含む）とする．ただし，家事労働（炊事，洗濯，掃除，ふとんの上げ下ろしなど）および身体を使った職業（農作業，漁業，大工など）は含めない」と定義した．

その上で運動習慣の状況を把握するために，運動実践頻度を「週2回以上」，「週1回」，「月1―2回」，「なし」の4カテゴリで尋ねた．ところで，ACSM（1990）は週3日以上の運動を勧めているが，①筆者らのこれまでの経験から週3日以上を基準にすると，対象者分布に偏りが生じるために基準を下げる必要があること，②「健康日本21」では週2回以上を基準としていること（健康・体力づくり事業財団，2000），③文部科学省のスポーツ振興基本計画が週1回以上のスポーツ実践を目標としていること，④低頻度実践者と実践していない者を分けたかったこと，を踏まえて上記のカテゴリを設けることとした．

次に，運動実践を妨げる障壁（barrier）を，環境によるものと個人によるもの（生理的，行動的，心理的要因を含む）に二分しているU.S. De-

partment of Health and Human Services（以下「USDHHS」と略す）（1999, pp. 69–72）の定義，そして運動継続を誘発する要因として心理的・環境的・人的の3つを挙げている長ヶ原（2005）の概念を考慮しながら質問紙を以下のように構成した（健康・体力づくり事業財団，2004）（付録）．

(1) 対象者全員：年齢（回答日における満年齢），性，身長，体重，喫煙，飲酒，疼痛，疾病，日常生活活動（ADL），精神的疲労，睡眠，休養，自由時間，外出頻度，運動の実践頻度，運動に対するビリーフ（belief）．

(2) 運動習慣のない，もしくは月1—2回実践している対象者：運動を（あまり）しない理由，運動実践に際して期待する外部からの働きかけ，実践するのであればその運動の種類．

(3) 週1回もしくはそれ以上実践している対象者：継続期間，運動を始めたきっかけ，継続できた理由．

2）データ収集

質問紙は磯部町保健センターと磯部町老人クラブ（全18クラブ）の協力を得て，老人クラブの会長を通して各クラブ員へ配布した．老人クラブに所属していない者には，当該地域の老人クラブ会長もしくは保健センター職員が配布した．配布は原則として手渡しとした．調査に関する注意点を記載した文書を作成することで，調査目的の理解を促し，できる限り回答に偏りのない正確なデータを収集できるようにした．質問紙は無記名にて，かつ密封できる無地の封筒に入れるよう依頼することで個人を特定できないようにして，老人クラブ会長が回収，もしくは保健センター職員に直接提出してもらうようにした．

3）調査の実施期間

2003年11月1日（配布開始）—2003年12月19日（回収締め切り）．

4. データ分析と統計処理

運動実施状況に基づいて対象者を分類し，それぞれの特徴を把握した．次に，各群が運動を実践する際に望んでいる事柄などを勘案し，課題を提案した．

データの等分散をLevene検定によって仮定できた場合は，一元配置分散分析を平均値の群間比較に用いた．有意差が認められた際には事後検定に最小有意差検定を用いた．データの等分散を仮定できない場合はKruskal Wallis検定を施した．割合の比較には$\chi 2$検定を用いた．統計処理にはSPSS（Ver. 11.5.1 J）を用い，有意水準はすべて5%とした．

III 結　　果

1. 対象者全員の特徴

質問紙に回答した者は675名中460名（68.1%）

表1　対象者の特徴（n = 460）

項目	人数（%）
年齢（歳）	
65	101（22.0）
66	69（15.0）
67	91（19.8）
68	81（17.6）
69	70（15.2）
回答なし	48（10.4）
性	
男性	196（42.6）
女性	224（48.7）
回答なし	40（8.7）
疾病	
なし	275（59.8）
あり（以下，多重回答*）	185（40.2）
高血圧	103（22.4）
糖尿病	34（7.4）
高脂血症	16（3.5）
虚血性心疾患	15（3.3）
前立腺肥大	5（1.1）
不整脈	5（1.1）
疼痛	
なし	234（50.9）
あり（以下，多重回答*）	226（49.1）
腰	118（25.7）
膝	103（22.4）
肩	52（11.3）
足首	11（2.4）
足	10（2.2）

年齢は回答日における満年齢．
（ ）内は回答者全体に対する比率を示している．
*データ数が5以上のケースのみを示している．

であり，その内訳は男性344名中196名（57.0％），女性331名中224名（67.7％），性別未回答40名であった（表1）．年齢は質問紙に記入してもらうようにしていたため，非回答者の年齢分布は把

表2　運動頻度別にみた対象者の特徴

群	A	B	C	D	事後検定
運動頻度	週2回以上	週1回	月1—2回	なし	
人数	97	29	35	299	
（男性；女性；回答なし）	(58.8;36.1;5.2)	(27.6;69.0;3.4)	(37.1;54.3;8.6)	(40.1;50.2;9.7)	
年齢（歳）*	67.0 ± 1.5	66.4 ± 1.4	66.4 ± 1.4	66.6 ± 1.7	A > B, D
身長（cm）*	156.2 ± 10.0	156.1 ± 9.9	155.8 ± 7.0	160.1 ± 7.6	D > A, B, C
体重（kg）*	56.4 ± 9.2	57.0 ± 8.4	59.7 ± 9.3	60.8 ± 12.7	D > A
BMI（kg/m^2）*	23.3 ± 2.8	24.6 ± 3.3	23.4 ± 2.3	22.9 ± 2.9	B > A, D
喫煙（過去あり；ない；あり）	(16；66；18)	(11；82；7)	(7；83；10)	(13；75；11)	
飲酒（毎日；週3～4日；週1～2日；ほとんどない）	(25；8；6；61)	(12；8；4；77)	(27;10;3;60)	(27；5；4；64)	
一人あたりの疾病数	0.43 ± 0.59	0.46 ± 0.61	0.69 ± 0.76	0.48 ± 0.60	
一人あたりの疼痛数	0.72 ± 0.83	0.54 ± 0.85	0.76 ± 0.69	0.55 ± 0.72	
日常生活活動（ADL）（とても難しい1；とても簡単5）*	3.76 ± 0.92	4.27 ± 0.78	4.23 ± 0.77	4.16 ± 0.89	B, C, D > A
精神的疲労（大いに感じる1；まったく感じない5）*	3.05 ± 1.05	3.58 ± 0.83	3.03 ± 0.91	3.51 ± 1.10	B, D > A, C
睡眠（大いに不足1；十分5）*	3.23 ± 1.00	3.79 ± 0.96	3.69 ± 1.14	3.68 ± 1.16	B, C, D > A
休養（大いに不足1；十分5）*	3.27 ± 0.92	3.76 ± 1.00	3.59 ± 0.98	3.88 ± 1.04	D > A, C
自由時間（ほとんどない1；たくさんある5）*	3.46 ± 1.11	3.61 ± 0.97	3.79 ± 0.99	3.83 ± 1.12	D > A
外出頻度（出かけない1;ほとんど毎日5）*	2.81 ± 1.34	3.06 ± 1.14	2.71 ± 1.21	3.38 ± 0.91	D > A, C

（　）内は各群内での百分率；* 群間に有意差あり（$P < 0.05$）；事後検定には最小有意差法を用いた．

表3　運動頻度別にみた運動に対するビリーフ（belief）

群	A	B	C	D	事後検定
人数	97	29	35	299	
運動頻度	週2回以上	週1回	月1—2回	なし	
［肯定的なビリーフ］					
仲間ができる*	3.7 ± 1.1	3.7 ± 1.1	3.9 ± 0.9	3.5 ± 0.9	—
毎日が楽しくなる*	3.8 ± 1.0	3.9 ± 0.8	3.8 ± 0.8	3.4 ± 0.9	A, B, C > D
ストレスを発散できる*	3.9 ± 0.9	3.9 ± 0.7	3.8 ± 0.8	3.6 ± 0.9	A > D
体力が向上する*	3.8 ± 1.0	3.8 ± 1.0	3.9 ± 0.7	3.5 ± 0.9	A > D
健康になれる*	4.0 ± 0.9	3.8 ± 0.8	3.8 ± 0.9	3.6 ± 1.0	A > D
［否定的なビリーフ］					
関節・筋肉が痛くなる*	2.5 ± 1.1	2.6 ± 1.0	2.9 ± 1.2	3.1 ± 1.1	D > A
ケガをする*	1.8 ± 0.9	1.8 ± 0.8	2.2 ± 0.9	2.4 ± 1.1	D > A, B
恥をかくことになる*	1.6 ± 0.8	1.8 ± 1.1	1.8 ± 0.8	2.3 ± 1.1	D > A, B, C
忙しくなる*	2.2 ± 1.0	2.7 ± 1.1	2.8 ± 1.0	3.0 ± 1.0	B, C, D > A
疲れる*	2.4 ± 1.0	2.5 ± 1.0	2.8 ± 1.0	3.1 ± 1.0	D > A, B

各設問に対して対象者は以下の5つの選択肢より回答した；(1) まったくそう思わない、(2) あまりそう思わない、(3) ふつう、(4) ややそう思う、(5) はっきりそう思う；*群間に有意差あり（$P < 0.05$）；事後検定には最小有意差法を用いた．

握できなかった．

運動頻度別に対象者（460名）を4分割し，それぞれの特徴を把握した（表2）．A群（週2回以上運動している）が97名（21.1％），B群（週1回運動している）が29名（6.3％），C群（月1―2回）が35名（7.6％），D群（運動していない）が299名（65.0％）であった．

A―D群の特徴を比較したところ，その多くに有意差を認めた（表2）．具体的には，週2回以上運動しているA群には，高齢，高い精神的疲労度，睡眠不足，少ない休養，少ない自由時間という特徴があり，条件が良好でない中で運動を実践していることが示された．一方，運動習慣のないD群はその逆の特徴を示した．運動実践の妨げになると思われる疾病や疼痛の数に有意差はなかった．群内における男女の比率はA群，B群で有意に異なっており，それぞれ男性，女性が多く含まれていた．

表3に頻度別にみた運動に対するビリーフを示した．すべての項目において有意差を認め，A―C群は肯定的なビリーフを強く持つ一方で，否定的なビリーフをあまり有していなかった．D群は3群と逆の結果を示し，特に否定的なビリーフを強く有していた．

2. 運動習慣のない，もしくは月1―2回実践している対象者について

C群とD群に運動しない理由を多重回答で求めたところ，両群とも平均で一人あたり2つの理由を挙げており，理由の数に有意差を認めなかった．両群とも「機会がないから」，「時間がないから」と回答した者が多かった（表4）．しかし，「運動施設や場所が近くにないから」，「仲間がいないから」に回答した者はC群に多かったが，D群では有意に少なかった．C群が「運動施設や場所」，「仲間」といった具体的な条件の不備を挙げているのに対し，D群では「運動をしたいと思わないから」，「めんどうだから」といったモチベーションの低さを挙げていた．"もっとも当てはまる理由" として単一回答を求めた場合でも同様の結果が得られた．

"どのような働きかけが外部からなされたら運

表4 運動頻度の少ない/ない者における「運動しない理由」

	当てはまる理由（多重回答：%）		もっとも当てはまる理由（単一回答：%）	
群	C	D	C	D
人数	35	299	35	299
運動頻度	月1―2回	なし	月1―2回	なし
運動施設や場所が近くにないから	37.5	11.0*	22.9	2.5*
機会がないから	29.2	38.5	14.3	20.4
時間がないから	25.0	33.5	17.1	20.4
仲間がいないから	25.0	8.0*	5.7	1.3
健康や体力に自信がないから	16.7	12.0	11.4	4.5
孫の世話があるから	16.7	6.0	11.4	1.9*
運動をしたいと思わないから	12.5	19.0	0.0	12.1
疾病・ケガを有しているから	8.3	15.5	5.7	12.1
運動の方法が分からないから	4.2	4.5	0.0	0.0
指導者がいないから	4.2	4.0	0.0	1.3
めんどうだから	0.0	11.5	0.0	7.0
運動が嫌いだから	0.0	4.0	0.0	2.5
介護に手がかかるから	0.0	3.0	0.0	3.2
家族が反対するから	0.0	0.5	0.0	0.0
その他	1.0	13.5	11.4	10.8

*C群と比較して有意差あり（$P < 0.05$）．

表5　運動頻度の少ない/ない者が求めている「外部からの働きかけ」

群	C	D
人数	35	299
運動頻度	月1—2回	なし
運動場所への送迎（はいと回答した者の割合）	47.4	17.6 *
いろいろな運動方法の紹介（はいと回答した者の割合）	51.4	26.2
運動教室や行事の開催案内（はいと回答した者の割合）	52.6	22.2 *
開催回数（月1回：週1回：週3回）	(85.7：14.3：0.0)	(59.6：29.8：10.6)
参加料（無料がよい：有料でよい：どちらでもよい）	(46.7：13.3：40.0)	(50.9：7.0：42.1)
一緒に運動する仲間の紹介（はいと回答した者の割合）	55.0	29.1
仲間の人数（1—2名：5—6名：10名以上）	(0.0：46.2：53.8)	(17.2：44.8：37.9)
指導者の紹介（はいと回答した者の割合）	66.1	22.6 *
指導者の性別（同性：異性：どちらでもよい）	(22.0：0.0：77.8)	(14.1：0.0：85.9)
指導者の年齢（自分より若い：自分と同年齢：どちらでもよい）	(8.6：8.6：82.6)	(12.7：20.6：66.7)
医師や保健師、家族、仲間からの勧め（はいと回答した者の割合）	47.4	41.7

（ ）内は各群での回答者を100%とした際の割合：*C群と比較して有意差あり（$P < 0.05$）.

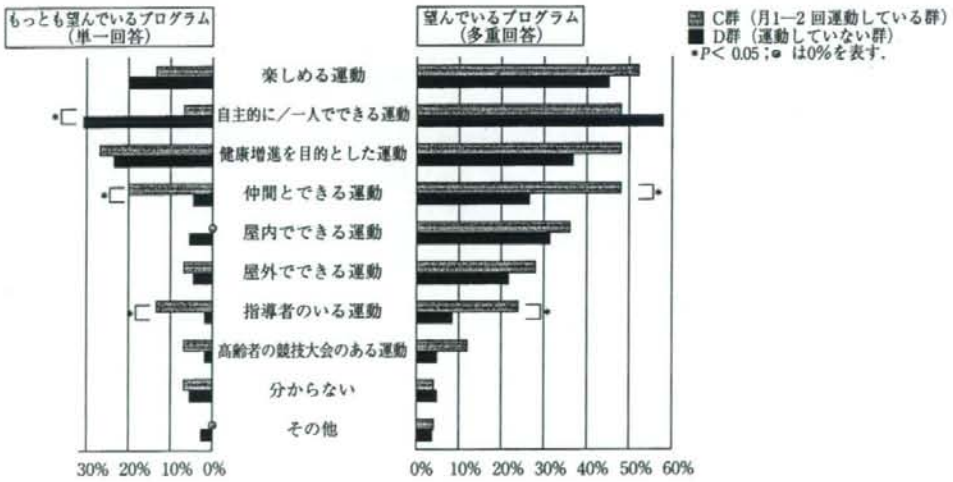

図1　運動頻度の少ない/ない者の考える「実践可能性の高い運動」

動を実践しそうか" という設問に対して，D群はC群ほど外部からの働きかけを望んでいなかった（表5）．特に「運動施設への送迎」や「教室・行事の案内」，「指導者の紹介」は希望していないことが分かった．次に，実践する可能性の高い運動を尋ねたところ，両群とも「楽しめる運動」，「自主的に/一人でできる運動」，「健康増進を目的とした運動」を希望する者が多かった（図1）．C群とD群の違いとして，他者との関わりを希望しているか否かという点が認められた．つまり，C群の48.0%が「自主的に/一人でできる運動」を希望する運動の一つとして挙げているものの，「もっとも希望する運動」に位置づけていたのはわずか6.7%であった（図1）．その一方で，C群は「仲間とできる運動」（20.0%）や「指導者のいる運動」（13.3%）を強く希望しており，D群

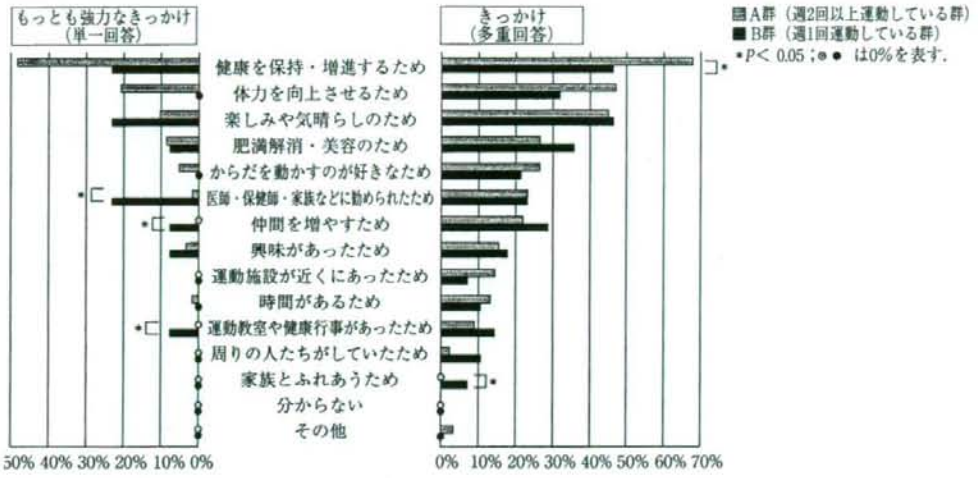

図2 運動頻度が週1回もしくはそれ以上の者における「運動開始のきっかけ」

（それぞれ4.5%，1.8%）と有意に異なっていた．

3. 週1回もしくはそれ以上実践している対象者について

運動頻度の向上を目的として，運動を週1回もしくはそれ以上実践している者（A群とB群）を対象に検討した．両群に運動継続期間を尋ねたところ，A群では10年以上（32.2%），5—9年（24.4%），3—4年（27.8%）に多くが回答し，一方B群では1—2年（34.6%），半年—1年未満（7.7%），半年未満（23.1%）に多くが回答し，頻度だけでなく運動期間の違いも明確であった．両群とも「健康を保持・増進するため」，「体力を向上させるため」，「楽しみや気晴らしのため」が運動開始のきっかけとなったという回答が多かった（図2）．「医師・保健師・家族などに勧められた」ことをきっかけにしているのは両群とも多かったが，「もっとも強力なきっかけ」でもあったと回答したのはA群1.7%であるのに対してB群23.1%と有意な差があった．また，B群ではA群に比べると「仲間を増やすため」，「運動教室や健康行事があったため」，「周りの人たちがしていたため」，「家族とふれあうため」という理由に多くが回答していた．

運動継続要因を尋ねたところ，両群とも運動開始のきっかけと類似した項目を挙げた．すなわち，「健康になったから」，「体力が向上したから」，「楽しいから」に多くの回答を得た．ただし，継続しているもっとも強力な要因として「楽しいから」と挙げたのはA群13.1%であるのに対してB群40.0%と有意に多かった．一方，「健康になったから」と挙げたのはA群29.5%であるのに対してB群5.0%と有意に少なかった．「体力が向上したから」（多重回答）という設問においても，A群34.1%であるのに対してB群10.7%と有意に少なかった．

4. 各群の特徴のまとめと課題の設定

これらの結果をもとにした各群の特徴を図3に示した．併せて，それぞれ群の特徴とその群よりも実践頻度の高い群の特徴を考慮しながら，実践頻度を高められるような内容をその時点（段階）における課題として設定した．各群の特徴と課題は次の通りである．

1）週に2回以上運動している群では，健康・体力の改善効果を認識していることが継続の主因となっており，これを踏まえて長期にわたった運動頻度の維持を目標とする．