Exercise and aging: relationships between functional fitness, body mass index and psychosocial variables

*Exercice physique et vieillissement : relations entre capacité physique
fonctionnelle, indice de masse corporelle et variables psychosociales*

**Philippe de Souto Barreto, Enguerran Macia, Nicole Chapuis-Lucciani et
Anne-Marie Ferrandez**

Édition électronique

URL : <https://journals.openedition.org/bmsap/6488>

DOI : 10.4000/bmsap.6488

ISSN : 1777-5469

Éditeur

Société d'Anthropologie de Paris

Édition imprimée

Date de publication : 1 juin 2009

ISSN : 0037-8984

Référence électronique

Philippe de Souto Barreto, Enguerran Macia, Nicole Chapuis-Lucciani et Anne-Marie Ferrandez,
« Exercise and aging: relationships between functional fitness, body mass index and psychosocial
variables », *Bulletins et mémoires de la Société d'Anthropologie de Paris* [En ligne], 21 (1-2) | 2009, mis en
ligne le 07 juin 2010, consulté le 01 juin 2021. URL : <http://journals.openedition.org/bmsap/6488> ;
DOI : <https://doi.org/10.4000/bmsap.6488>

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EXERCISE AND AGING: RELATIONSHIPS BETWEEN FUNCTIONAL FITNESS, BODY MASS INDEX AND PSYCHOSOCIAL VARIABLES

EXERCICE PHYSIQUE ET VIEILLISSEMENT : RELATIONS ENTRE CAPACITÉ PHYSIQUE FONCTIONNELLE, INDICE DE MASSE CORPORELLE ET VARIABLES PSYCHOSOCIALES

Philippe DE SOUTO BARRETO¹, Enguerran MACIA²,
Nicole CHAPUIS-LUCCIANI², Anne-Marie FERRANDEZ¹

ABSTRACT

The purpose of this study was threefold: (1) to assess older exercisers' functional fitness (FF), (2) to study the relationships between FF and psychosocial variables among older exercisers, and (3) to compare levels of body mass index (BMI), handgrip strength, and psychosocial variables, between exercisers and non-exercisers. Older women who were exercisers (Es, n = 17, age 59-86) and non-exercisers (NEs, n = 41, age 61-85) were tested on self-esteem, aesthetic body care, BMI and handgrip strength. Es were also tested for functional fitness using the Senior Fitness Test battery. High levels of self-esteem and aesthetic body care were observed in both groups. Handgrip strength was higher for the Es than for the NEs. In Es, FF was high (especially in lower-body strength and dynamic balance/agility) and BMI was correlated with self-esteem. Although the results indicated high levels of FF, self-esteem, and aesthetic body care for Es, further research, especially exercise-controlled trials, is needed to confirm the impact of bodily expression on physical function and well-being in the elderly.

Keywords: older adults, physical activity, bodily expression, physical fitness, Senior Fitness Test, self-esteem.

RÉSUMÉ

Cette recherche avait un triple objectif : 1) évaluer la capacité physique fonctionnelle (CPF) chez des aînées qui pratiquent un exercice physique, 2) étudier les relations entre CPF et variables psychosociales chez ces personnes, et 3) comparer les niveaux d'indice de masse corporelle (IMC), de force de préhension de la main, et les variables psychosociales de celles-ci à des personnes qui ne pratiquent pas d'exercice physique. On a testé l'estime de soi, l'attention portée à l'esthétique du corps (APEC), l'IMC, et la force de préhension de la main chez des femmes âgées, les unes (groupe E, n = 17, 59-86 ans) pratiquant une activité physique, les autres ne pratiquant pas d'activité physique (groupe NE, n = 41, 61-85 ans). On a aussi évalué dans le groupe E la CPF au moyen de la batterie « Senior Fitness Test ». Des niveaux élevés d'estime de soi et d'APEC ont été observés dans les deux groupes. La force de préhension de la main était plus élevée

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1. UMR 6578, Adaptabilité Bioculturelle, Université de la Méditerranée, CNRS-EFS, Faculté de Médecine, Secteur Nord, 51 boulevard Pierre Dramard, 13344 Marseille CEDEX 15, France, e-mail: philipebarreto81@yahoo.com.br
  2. UMI 3189, Environnement, Société, Santé, Université de la Méditerranée, Faculté de Médecine, Secteur Nord, boulevard Pierre Dramard, 13344 Marseille CEDEX 15, France.

dans le groupe E que dans le groupe NE. Le groupe E présentait des scores élevés de CPF (en particulier pour la force de l'hémicorps inférieur et l'équilibre dynamique). Dans ce groupe, l'IMC était corrélé à l'estime de soi. Bien que les résultats aient montré des niveaux élevés de CPF, d'estime de soi, et d'APEC dans le groupe E, des recherches ultérieures, en particulier des recherches d'intervention, sont nécessaires pour évaluer directement l'impact, chez les personnes âgées, de l'expression corporelle sur l'aptitude physique et le bien-être.

Mots-clés : vieillissement, activité physique, expression corporelle, capacité physique fonctionnelle, Senior Fitness Test, estime de soi.

INTRODUCTION

Aging is a process characterized by physiological declines in several organic systems (Tanaka, Seals 2003; Nair 2005), and cognition (Smith *et al.* 2005). It can lead to disabilities and dependencies. The ability to optimally carry out everyday activities indicates that these physiological declines have not yet affected functional fitness (FF), or that the magnitude of their negative impact is still insufficient to trigger a disablement process. FF is defined as "having the physiologic capacity to perform normal everyday activities safely and independently without undue fatigue" (Rikli, Jones 1999a), and its decline can determine the development and progression of frailty, disability, and dependence, that is, the disablement process (Barreto, Ferrandez 2007).

Although aging is partially genetically determined (Kirkwood 2003), there are other factors that have strong impact on the way in which someone ages, including psychosocial factors (for example, self-esteem -SE) and physical exercise and activity. The latter factors (physical exercise and activity) permit maintenance of FF (Toraman *et al.* 2004) and cognitive functions (Colcombe, Kramer 2003). Moreover, an active lifestyle is frequently and positively associated with levels of social functioning (McAuley, Blissmer 2000; Devereux *et al.* 2005), SE (McAuley *et al.* 2000), self-related health (Norman *et al.* 2002; Haveman-Nies *et al.* 2003), and with body image (Wilcox *et al.* 2006), all aspects that influence aging. However, some authors indicate that it is still difficult to establish a direct relationship with these factors (Netz *et al.* 2005). In a review on this subject, Spirduso and Cronin (2001) acknowledged both a direct influence of physical exercise and activity on the quality of life, and the role played by FF as a mediator in this relationship. In this functional-aging perspective (maintenance of independence and autonomy), physical exercise and

activity play an important role because they work together in maintaining and improving both psychosocial state and FF during aging, the latter being considered a cornerstone for successful aging and the variable most frequently associated with it (Depp, Jeste 2006).

There are not many studies of older adults about the effects of dance exercise on FF, psychosocial factors, and cognitive function. Turkish folklore dance (Eyigor *et al.* 2009), dance-based exercise (Federici *et al.* 2005), and social dance (Verghese 2006) were found to contribute to achieving better balance. Dance-based aerobic exercise was found to improve agility and the risk of falling (Shigematsu *et al.* 2002), and line dancing was found to reduce lower-body bone loss (Young *et al.* 2007). The mechanisms of how dance contributes to achieving better balance are not well known in older adults. However, some studies have shed light on this question in young adults. Golomer *et al.* (1999) indicated that classical dancers are less dependent on vision than non-dancers for postural control of dynamic equilibrium. Simmons (2005) found a superior postural control mechanism in trained ballet dancers compared to non-dancers. In older adults, the same mechanisms may explain the better balance found in dancers compared to non-dancers.

The purpose of the present study was to find out (a) whether older women who exercised have good FF, (b) what main physical abilities are likely to be positively affected by this activity, and (c) if these exercisers (Es) have better psychosocial scores (SE and aesthetic body care-ABC) than another population made up of older women who are not exercisers (NEs).

METHODS

The study was divided into two parts. The first concerned just the group that exercised (E). Participants' FF

data (women age 60 years and over) were collected using the Senior Fitness Test (SFT) battery (Rikli, Jones 2001). This battery assesses upper—and lower-body strength, upper—and lower-body flexibility, aerobic endurance, dynamic balance/agility (see *table 1*), and Body Mass Index (BMI, assessed by weight, in kilograms, divided by height squared, in meters). The relationships of FF data to other variables were analyzed within the E group. The second part of the study compared the SE, ABC, BMI, and handgrip strength of the E group to another sample of older women (NE group). The NE group was not assessed on the SFT battery. Both groups were from Marseille, France. The study complies with ethical standards in France.

Bodily Expression

The type of exercise performed by the E group was a kind of dance labelled “bodily expression”, which is based on principles of fall and recovery. Movements are executed with music and stress the expression of emotions. During exercise classes, participants were free to create and execute movements as they wished. The exercise was also characterized by movements with large amplitudes in joints, particularly the hip and shoulders, with several degrees of freedom. We hypothesized that Es would have good levels of dynamic balance/agility, lower-body strength, and lower- and upper-body flexibility.

Participants

The E group was composed of 17 community-dwelling independent-living older women from Marseille, France (ages 59 to 86). They had been participating in the bodily expression exercise for 27.75 ± 12.65 years (mean and standard deviation), for about 1.59 ± 0.61 times a week. Participants were members of two clubs with the same exercise teacher and were affiliated with the French Federation of Dance, which means that they all had medical insurance and underwent clinical health assessment every year. They were 72.77 ± 8.93 years old and had 14.00 ± 3.08 years of formal education.

The NE group was set up using a database from a Ph.D study by Macia (2006), on older adults living in Marseille. The exclusion criteria for this group were: being 58 years-old or younger, being a man, being dependent, living in a care facility, and having less than 11 years of formal education. From a database of about 400 people,

the final sample for the NE group contained 41 people. They were 71.02 ± 6.32 years old (range: 61 to 85) and had 12.93 ± 1.93 years of formal education.

Measures

NE group

Participants were interviewed individually. A sociodemographic and health questionnaire was applied (Macia 2006). SE was measured with the “Echelle Toulousaine d’Estime de Soi pour Personnes Agées”, which has been used on an elderly French population (Piquemal-Vieu 1999). This instrument is composed of 19 items, 10 positive ones (*e.g.*, “I have a good opinion of myself”), and 9 negative ones (*e.g.*, “It is difficult to be who I am”). Responses were rated in a 5-point scale, which gave a rating varying from 19 to 95, with higher scores representing greater SE. ABC was measured using a scale developed by Macia (2006) with an elderly population from Marseille, France. This scale is composed of 7 items (*e.g.*, “Do you pay attention to your body shape?”) and was designed to determine the degree of care of one’s appearance in older women. It gives a rating between 0 and 7, with higher scores representing greater ABC. At the end of the interview, handgrip strength (a marker of physical function and regular physical activity, Spirduso, Cronin 2001) was assessed using a hand-held dynamometer (Stoelting Co.) that gives a measure to the nearest kilogram. The other measures were height, weight, and then BMI.

E group

First, participants in group E signed an informed consent form which explained the study objectives, procedures, and health risks. After that, they took the physical functional tests in the SFT battery. These tests were administered by an experienced professional in fitness assessment (including experience on the SFT battery). They took place in the usual room in the two clubs, during an exercise class, and in the presence of the exercise teacher.

FF Tests

The physical tests were organized in a circuit format. Height (to the nearest .1cm) and weight (nearest .1 kg)

were measured right before the performance tests. After receiving information about the test performance and a demonstration of each one by the test administrator, participants executed some practice trials, and completed the SFT battery as validated by Rikli and Jones (2001).

The 6-minute Walk Test (to measure aerobic endurance) was replaced by the 2-minute Step Test due to cold weather and lack of sufficient space, as stipulated by the authors (Rikli, Jones 2001, p. 34). The six tests of the SFT battery are detailed in table I.

Test	Assessed physical capacity	Test description	Score	ICC (R)*
30-sec Chair Stand	Lower-body strength	Sit up and down on a chair for 30 sec., as fast as possible (one test trial)	The number of complete stands executed	.89
Arm Curl	Upper-body strength	Seated holding a weight (2.27kg for women) with the dominant hand, perform arm flexions for 30 sec., as fast as possible (one test trial)	The number of full arm flexions	.81
8-feet-up-and-go	Dynamic balance/agility	Stand up from a seated position, walk 8 ft, go around an object, and return to the initial position as fast as possible (two test trials)	Best trial to the nearest .01 sec	.95
Back Scratch	Upper-body flexibility	Approach the hands to each another on the back, with one arm placed behind the head and the other over the hip (two test trials)	Best trial to the nearest .5cm	.96
Chair Sit-and-Reach	Lower-body flexibility	In a seated position, one leg extended and the other in a 90°-flexion, reach as far as possible in the direction of the toe (two test trials)	Best trial to the nearest .5 cm	.95
2-Minute Step	Aerobic endurance	At a self-paced rhythm, touch with the knees, alternately, on an elastic placed at a point midway between the patella and the iliac crest for 2 minutes (one test trial)	The number of times the right knee touches the elastic	.90

* ICC values were established by Rikli and Jones (1999b).

Table I—Senior Fitness Test (SFT) battery characteristics and their intraclass correlation coefficients (ICC).

Tabl. I - Caractéristiques de la batterie de tests SFT et valeurs des coefficients de corrélation intra classes (ICC).

Participants were asked to “do the best they can on all tests, but never to push themselves to a point of overexertion or beyond what they think is safe for them” (Rikli, Jones 2001: 60).

For each test, the scores of each participant were classified with respect to percentile tables (Rikli, Jones 2001) of normative data (Rikli, Jones 1999a), for each 5-year age group. A rating from 1 to 20 was given according to each 5-percentile range, with 1 being the

worst performance (score below the 5th percentile), 2 the score from the 5th to the 9th percentile, and 20, the best performance (in or above the 95th percentile). This defines a normalized score. Then we established a global score, which was the sum of the normalized scores at the six SFT tests. This was called the overall FF score. It represents a participant’s performance in relation to the normative data (women of the same age range). The overall FF score varies between 6 and 120.

Interview

About three weeks after the tests, participants were interviewed (interviews were recorded) in their home. After the physical tests, one of the exercisers expressed her intention to drop out of the study for personal reasons, so she was not interviewed.

The initial conversation addressed the participant's physical exercise history in general, her experience with bodily expression in particular, and her daily physical activity level. The questions were about when she had begun physical activity, weekly frequency, session duration, and self-related intensity of physical effort, the so-called ratings of perceived exertion (RPE).

RPE was measured for all physical activities and exercises that participants currently perform, including bodily expression, using the Modified 0-10 Borg Scale (Kendrick *et al.* 2000). It is important to underline that RPE scales, particularly Borg's scales (Chen *et al.* 2002), are useful, validated instruments for measuring effort (American College of Sports Medicine—ACSM 1998) and that they have already been utilized with elderly populations in Canada (Allman, Rice 2003), Australia (Withers *et al.* 2006), and France (Vanbiervliet *et al.* 2003; Corone *et al.* 2009).

Right after this initial conversation, the same sociodemographic and health questionnaire, and the same scales for measuring SE and ABC used in the NE group were applied. After the questionnaire, participants had their handgrip strength measured with the same dynamometer as for the NE group.

Statistical Analyses

For the E group, Spearman's rank correlations were used to find relationships between variables (age, SFT scores, normalized FF scores, handgrip strength, height, weight, BMI, SE, ABC). A Friedman rank-sum test (ANOVA) and a post hoc multiple-comparison procedure, with an alpha adjusted for the number of pairwise comparison tests (method of Siegel, Castellan 1988), were used to look for performance differences across the SFT tests. The Wilcoxon rank-sum test was used to compare groups E and NE on handgrip strength, height, weight, BMI, SE, and ABC. For all statistical tests, the alpha level

was set at .05. Statistical analyses were run using SPSS version 11.0, and R version 2.8.1.

RESULTS

FF Data (E group)

Most of the participants' scores on SFT tests fell into the normal (*i.e.*, intermediate) range (25th $\leq$ performance $\leq$ 75th, according to Rikli and Jones 2001), especially in the normal-superior quartile or upper (superior) range (performance $>$ 75th). Table II gives the participants' scores on each test, and their classification in relation to the normative data for each 5-year age range starting from 60 to 64 years until the oldest age group (85-89 years).

For SFT, correlations were found between the Up and Go (assessed in seconds) and Step tests (assessed in number of repetitions, $r = -.57$, $p = .02$), and between the Step test and the Chair Stand test (assessed in number of repetitions, $r = .51$, with $p = .03$). SE exhibited a correlation tendency with Step ($r = .45$, $p = .08$), while ABC was correlated with Chair Stand ($r = .55$, $p = .03$). When normalized scores were used, Up and Go was correlated with age ($r = .60$, $p = .01$) and exhibited a correlation tendency with weight ($r = -.49$, $p = .052$), and Chair Stand was correlated with BMI ($r = .50$, $p = .05$).

Table III shows the participants' normalized scores on each SFT test and the overall FF score calculated by adding all the normalized scores for each person. The best outcomes were obtained, in decreasing order of magnitude (Friedman chi-squared = 19.15, $p = 0.002$), for Chair Stand and Up and Go, whose means were close to the 75th percentile, *i.e.*, almost in the upper range. Back Scratch was also good, with mean performance ranging between the 65th and 70th percentiles. It was followed by Step (means between the 60th and 65th percentiles). Significant differences among SFT tests were found for two comparisons: Chair Stand had higher scores than Arm Curl and Sit and Reach. After dividing the overall FF score by the number of SFT tests (six), the score of Es ranged between the 60th and 65th percentiles.

Concerning the other variables, note the correlations between BMI and SE ($r = -.70$, $p = .002$), and between age and handgrip strength ($r = -.56$, $p = .01$).

Individual Code	Age	Sit and Reach		Arm Curl		Chair Stand		Back Scratch		Up and Go Mod.		Step		Score
		Percentile	Score (cm)	Percentile	Score (cm)	Percentile	Score (cm)	Percentile	Score (cm)	Percentile	Score (cm)	Percentile	Score (cm)	
S1	60	20-24	-3	75-79	19	≥95	22	80-84	7	75-79	4.25	70-74	103	
S2	62	55-59	7	30-34	14	25-29	12	45-49	-3	55-59	4.93	50-54	93	
S3	63	90-94	19.5	40-44	15	60-64	16	90-94	10	60-64	4.75	65-69	102	
S4	64	30-34	0	25-29	13	90-94	20	60-64	1	45-49	5.22	65-69	100	
S5	69	65-69	9.5	65-69	17	75-79	16	80-84	5.5	75-79	4.81	45-49	87	
S6	69	85-89	16	35-39	14	65-69	15	80-84	6	60-64	5.12	85-89	120	
S7	72	15-19	-5	45-49	14	80-84	16	45-49	-5.5	70-74	5.06	60-64	92	
S8	73	30-34	-5	80-84	18	90-94	18	70-74	2	90-94	4.01	75-79	104	
S9	76	5-9	-11	65-69	16	75-79	15	35-39	-8	80-84	4.75	80-84	106	
S10	76	40-44	0	65-69	16	50-54	12	75-79	3	45-49	6.38	35-39	77	
S11	79	20-24	-4	30-34	12	≥95	20	80-84	4	70-74	5.4	65-69	94	
S12	80	35-39	-2	55-59	14	65-69	13	35-39	-10.5	85-89	4.75	40-44	71	
S13	81	35-39	-2	40-44	12	75-79	14	80-84	3	75-79	5.6	20-24	58	
S14	84	90-94	15	90-94	18	≥95	22	70-74	0	90-94	4.19	90-94	111	
S15	84	55-59	3	50-54	13	65-69	13	75-79	2	80-84	5.04	80-84	96	
S16	86	45-49	-1.5	55-59	13	≥95	18	80-84	1	85-89	5.18	70-74	83	

Table II—Participants' scores on each SFT test and percentile classification with regard to normative data.

Tabl. II - Scores des participantes à chaque test du SFT et classification en percentiles (performance) par rapport aux données normatives.

Individual Code	Age	Sit and Reach	Arm Curl	Chair Stand	Back Scratch	Up and Go Mod.	Step	Overall FF Score
S1	60	5	16	20	17	16	15	89
S2	62	12	7	6	10	12	11	58
S3	63	19	9	13	19	13	14	87
S4	64	7	6	19	13	10	14	69
S5	69	14	14	16	17	16	10	87
S6	69	18	8	14	17	13	18	88
S7	72	4	10	17	10	15	13	69
S8	73	7	17	19	15	19	16	93
S9	76	2	14	16	8	17	17	74
S10	76	9	14	11	16	10	8	68
S11	79	5	7	20	17	15	14	78
S12	80	8	12	14	8	18	9	69
S13	81	8	9	16	17	16	5	71
S14	84	19	19	20	15	19	19	111
S15	84	12	11	14	16	17	17	87
S16	86	10	12	20	17	18	15	92
Mean		9.94	11.56	15.94	14.50	15.25	13.44	80.6

Table III—Normalized scores for each test in the SFT battery, and overall FF score for each participant.

Tabl. III - Scores normalisés pour chaque test de la batterie SFT, et score général de FF pour chaque participante.

Comparison Between Group E and Group NE

As table IV shows, the two groups did not exhibit any significant differences in age or formal education at $p < .10$. Neither BMI nor its components (height and weight)

differed statistically across populations. Concerning the psychosocial variables, neither SE nor ABC gave rise to any statistically significant differences. The only variable that differed across samples was handgrip strength, which was greater in group E ($W = 506$, $p = .002$).

	E group (n = 17)		NE group (n = 41)		Probability (p)
	Mean	Standard Deviation	Mean	Standard Deviation	
Age (yrs)	72.77	8.93	71.02	6.32	.50
Formal Education (yrs)	14.00	3.08	12.93	1.93	.17
Height (cm)	157.18	5.38	158.1	5.58	.63
Weight (kg)	59.64	7.32	65.46	19.6	.52
BMI	24.14	2.66	25.22	5.43	.99
Handgrip (kg)	27.94	5.31	22.02	5.84	.002
Self-Esteem	76.31	6.25	77.15	7.50	.58
ABC	5.88	1.36	5.85	1.24	.81

Table IV—Comparison between groups E and NE

Tabl. IV - Comparaison entre les groupes E et NE.

DISCUSSION

This study showed that Es have a FF score in the 60th to 65th percentile range, placing it above the 50th percentile, which represents the normative data average. This suggests that these older women have better overall fitness than their same-age peers. Moreover, certain physical abilities, which are part of FF, were more developed than others, in particular, lower-body strength and dynamic balance/agility. Upper-body flexibility, and to a lesser extent, aerobic endurance scores were also good in this group.

The excellent performance observed on the Chair Stand test, where the participants' mean performance was near the 75th percentile, supports our hypothesis that Es have good lower-body strength. Chair Stand (normalized score) was correlated with BMI in a negative way, which corroborates the result reported by Apovian *et al.* (2002), who found that a higher BMI impeded lower-body function. Another important aspect possibly influencing lower-body strength was RPE during bodily expression lessons. Indeed, the two participants who were overweight (30.7 and 28.6) were the only ones in this sample to report a light RPE (below a moderate intensity) during exercising, and they also exhibited the worst performance on the Chair Stand test (< 60th). We do not know if their large BMI led these older women to reduce their exertion level or vice versa. Moreover, four of the six highest scores (all scores above the 90th percentile) were related to climbing stairs daily, which suggests that exercising (at even a moderate intensity), adequate BMI (according to the World Health Organisation norms 2000), and climbing stairs daily, contribute to increasing lower-body strength.

Participants' mean score on the Up and Go test, like that obtained for Chair Stand, landed near the 75th percentile, making this their second-best score. This outcome supports our hypothesis that Es have good dynamic balance/agility, which is supported by studies in older adult dancers (Verghese 2006), and in older recreational gymnasts and folk dancers (Uusi *et al.* 1999). Our participants exhibited better dynamic balance/agility with advancing age in comparison with the general population: when normalized scores were used, the scores on the Up and Go test were positively correlated with age. Up and Go normalized scores tended also to be negatively correlated with weight. A possible explanation could be that being heavy, which in the elderly can easily signify excess fat, disrupts dynamic balance performance, and that

this negative effect progresses as age advances (perhaps also in relation to gradual reductions in muscle and bone mass in later life). However, more studies are needed to clarify a direct effect of bodily expression on balance.

Regarding the Back Scratch test, the participants' mean score fell between the 65th and 70th percentiles, so it was above the 50th percentile, and was the third best outcome among the FF capacities. Cyarto *et al.* (2008) demonstrated that exercise improved upper-body flexibility, as assessed by the Back Scratch test. Upper-body flexibility may have been influenced by bodily-expression exercising because its artistic aspect, which was highlighted by these exercisers, requires a large arm-motion amplitude, mainly on the shoulder joints. Moreover, it is possible that exercisers execute ample shoulder movements because the upper-body joints are not directly involved in the risk of falling (and fall-related fears), unlike movements in the lower-body joints.

For the Step test, the participants' aerobic endurance mean landed between the 60th and 65th percentiles, so it too was above the 50th percentile. The best performance in this physical capacity (every score above the 75th percentile) was obtained by participants who reported walking daily for 20 minutes or more, and climbing stairs. Moreover, the exercisers reported doing these activities, in addition to bodily expression, at a moderate or greater intensity. Thus, bodily expression and walking at a moderate intensity, and to a lesser extent, climbing stairs, may have contributed to aerobic endurance, with stair climbing being one of the potential mechanisms that accounts for the correlation between lower-body strength and aerobic endurance. This means that high lower-body function partially explained high aerobic endurance because the lower body muscles were involved in both the Chair Stand and Step tests. Delaying lower-body muscle fatigue at least partially represents a way of delaying general fatigue (aerobic endurance) as measured by a Step test. The observed relationship between dynamic balance/agility (Up and Go) and aerobic endurance (Step) can be explained simply by the fact that good balance is required on a Step test to obtain high performance.

In this context, although it must be recognized that a weekly exercising frequency (one or two times a week) alone cannot be considered responsible for high FF, regular exercising (bodily expression) and stair climbing on a daily basis, provided they are carried out at a moderate intensity, together with an adequate BMI, emerged here as the most important conditions for good FF, because they were linked to lower-body strength, dynamic balance, and

aerobic endurance, and thus overall fitness. However, our data do not allow us to conclude that bodily expression improved FF.

Concerning the psychosocial variables tested here, SE was correlated with BMI, and exhibited a correlation tendency with aerobic endurance. Although we do not know whether low SE (maybe through the mediation of reduced physical activity) is responsible for a high BMI or vice versa, we can suggest that SE was influenced in two ways: (a) aesthetic, because 13 of the 16 women interviewed said they paid attention to their physical shape, and (b) FF-related, because being overweight reduces FF (Apovian *et al.* 2002). Bodily expression is an exercise in which physical and artistic aspects are closely tied, and this can strengthen the relationship between SE and BMI. However, we do not know to what extent SE and BMI are related to bodily-expression exercise, or just to any exercise. Moreover, the correlation between BMI and SE could also be explained by cultural aspects present in Western countries, in which being overweight is undesirable. The tendential correlation between SE and aerobic endurance suggests that the fact of being resistant to general fatigue offers the possibility of continuing an active life in an efficacious manner and doing ordinary physical and social activities even in later life (such as going out with friends, playing with grandchildren), which may improve SE. Regarding ABC, this psychosocial variable was correlated with lower-body strength. This relationship is difficult to explain and needs further research to be clarified.

Comparison Between Group E and Group NE

The E and NE samples did not differ in age, years of formal education or body morphology (height, weight and BMI). One of the hypotheses of this research was not validated: the hypothesized better SE and ABC scores in Es than in NEs. However, this does not mean that bodily expression does not have an impact on these psychosocial variables, because the lack of a difference observed here can be explained by a ceiling effect in both variables, for both the E and the NE group. Indeed, the SE and ABC means (*table IV*) for groups E and NE largely exceeded theoretical means (57 and 3.5, respectively), possibly generating a ceiling effect. This may have been caused by the high educational levels, because this variable has already been found to increase both SE and ABC (Macia 2006).

Handgrip strength was negatively correlated with age in Es, corroborating the results of Panton *et al.*'s (2006) study. Furthermore, this was the only variable on which differences were found between samples (*table IV*), with Es reaching superior performance to NEs. The NE mean (22.02 ± 5.84 kg) is similar to that found by Shigematsu *et al.* (2002) in sedentary elderly women (mean age 78.6 ± 4.0 years) who were older than the women in both of our groups. This may mean that Es have more handgrip strength than NEs because they are probably more active in daily life (handgrip strength is a marker of regular physical activity; Spirduso, Cronin 2001). Daily activities (such as gardening, walking, climbing stairs), when executed at a moderate or greater intensity, appear to play an important role in older adults' physical performance (Withers *et al.* 2006).

By way of our handgrip strength results, we can confirm that Es have better physical function than NEs. It is acceptable to use handgrip strength as a measure of physical function because, as indicated by Spirduso and Cronin (2001), this variable is a predictor "for all functional limitations and disability outcomes" in older adulthood; it also predicts mortality risk among older women (Rolland *et al.* 2006).

CONCLUSION

Although the sample size was small, this study showed that Es presented a high overall FF level. This was corroborated by their high degree of handgrip strength. The main capacities possibly affected by bodily expression were lower-body strength and dynamic balance/agility, with the latter scores improving with advancing age. Adequate BMI constituted an important variable in determining FF as well as psychosocial level. Although the Es had high scores on psychosocial variables, they did not obtain higher levels than the NEs.

These results seem to show that both regular exercise and an active lifestyle, when done with at least a moderate level of intensity, worked together in accounting for high physical function. Moreover, these findings suggest that participation in bodily-expression exercise during aging, even in later life, is one of the possible ways of avoiding overweight-obesity and preserving physical function. However, the results of this study must be interpreted with caution, for two reasons. First, the exclusion criteria for the NE group, especially concerning educational level, may have induced high psychosocial scores. Second,

this study was cross-sectional, which does not allow us to conclude that bodily expression affects FF and psychosocial variables in older adults. Further research, especially exercise-controlled trials, is needed to confirm the impact of bodily expression on FF and well-being in the elderly. Moreover, bodily expression was generally associated with socialization and enjoyable feelings among the participants of our study, which may contribute to the long-term adherence to physical exercise found in this sample (Barreto 2007), which in turn would promote

independence, help meet the challenge of successful aging, and increase the quality of life during the aging process.

Acknowledgments

The authors thank the CNRS for funding, Vivian Waltz for help with the English version, the dance teacher Roselyne Aurenty and the participants of this study.

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