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RECOMMENDATIONS ON PHYSICAL ACTIVITY AND EXERCISE FOR OLDER ADULTS LIVING IN LONG-TERM CARE FACILITIES: A TASKFORCE REPORT

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Abstract: A taskforce, under the auspices of The International Association of Gerontology and Geriatrics – Global Aging Research Network (IAGG-GARN) and the IAGG European Region Clinical Section, composed of experts from the fields of exercise science and geriatrics met in Toulouse, in December 2015, with the aim of establishing recommendations of physical activity and exercise for older adults living in long-term care facilities (LTCF). Due to the high heterogeneity in terms of functional ability and cognitive function that characterizes older adults living in LTCFs, taskforce members established two sets of recommendations: recommendations for reducing sedentary behaviors for all LTCF residents and recommendations for defining specific, evidence-based guidelines for exercise training for subgroups of LTCF residents. In order to promote a successful implementation of recommendations, taskforce experts highlighted the importance of promoting residents' motivation and pleasure, the key factors that can be increased when taking into account residents' desires, preferences, beliefs and attitudes toward physical activity and exercise. The importance of organizational factors related to LTCFs and healthcare systems were recognized by the experts. In conclusion, this taskforce report proposes standards for the elaboration of strategies to increase physical activity as well as to prescribe exercise programs for older adults living in LTCFs. This report should be used as a guide for professionals working in LTCFs settings.

Key words: Physical activity, exercise, elderly, long-term care, nursing home, functional ability.

Introduction

Older adults living in long-term care facilities (LTCF) are a complex population, being characterized by high prevalence of dependency in activities of daily living (ADL), multimorbidity, and polymedication (1). Providing the best care for this population represents an immense challenge, particularly in the context of demographic projections for the coming decades in terms of the population ageing. In its recent report (2), the United Nations estimated that the number of people 60 years or over is expected to more than double between 2013 and 2050, with people aged 80 years or over constituting the age-group with the fastest rate of growth. The number of people living in LTCF (3, 4) is also expected to rise, leading to an important increase in health care costs (3-6).

One of the key challenges for the care of the institutionalized elderly is to maintain residents' functional ability, which is made up of subjects' intrinsic capacity and environmental characteristics (7), and the ability to cope with their functional limitations for as long as possible. Overall physical activity has been shown to protect against both the incidence of ADL disability and progression of the disability severity in the general population (8). Experts in LTCF research and clinical care, with the support of the International Association of Gerontology and Geriatrics and the World Health Organization, have already recognized the importance of exercise for the quality of care in the LTCF setting (9). Scientific evidence from recent meta-analyses have shown that exercise training, ie, a subset of physical activity that is planned, structured, repetitive, and purposeful, being generally used to improve/maintain physical and functional capacities, has been found to have positive effects on the ability to perform ADLs in LTCF residents (10, 11). Exercise training presents undoubtable advantages since it can positively impact several clinical outcomes that are often present in LTCF residents (eg, falls, cardiovascular diseases, mood disorders), with a low risk of adverse health events. Although exercise undeniably provides health benefits for older people (12), current physical activity guidelines for older adults (see Table 1) were established from a public health perspective (mainly focusing on the primary

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Box 1
Summary of key recommendations of physical activity and exercise for older adults in long-term care facilities

Increasing overall physical activity levels in daily life	**Exercise training for residents dependent in basic ADLs, but capable of ambulating/rising from a chair***
1. Motivation and pleasure are the key aspects to take into account in order to increase overall activity levels among older adults living in long-term care facilities (LTCF).	1. Every resident who has no contraindications must have a personalized exercise program as part of his/her healthcare plan.
2. LTCF staff should adopt strategies for breaking (short breaks of 2-5 minutes) the sedentary time of LTCF residents, twice or three times a day.	2. Exercise type. The best exercise type is a multicomponent training composed of muscle strength and cardiorespiratory endurance exercises as the core components. Other exercise types, particularly flexibility and balance, should be added to the exercise program whenever possible.
3. LTCF staff should systematically use simple strategies to stimulate residents to move, such as walking for going to the lunch/dining hall rather than using wheelchairs for people who are able to ambulate. The risk/benefit of using drugs that reduce patients' activity levels, especially psychotropic drugs, must be systematically evaluated. Physical restrains should be avoided. The use of medical equipment and LTCF architecture should be oriented to optimize residents' mobility.	3. Exercise intensity. Moderate-intensity exercises are feasible, effective and safe. Moderate exercises can be achieved by performing: (1) Strength. one or two sets of exercises, performed at 13-15 repetitions maximum; (2) Aerobic. exercises that noticeably increase heart and respiratory frequency, without generating breathlessness or undue fatigue (scoring 5 or 6 in a 10-point scale of perceived effort). High-intensity exercises can be executed, but it may require a closer monitoring.
4. LTCF staff should organize group activities that are motivating and pleasant, such as groups to look after the garden, dance, or walk in green spaces.	4. Frequency. Twice a week, with an interval of at least 48hrs between sessions. Higher weekly frequency is safe and may be feasible for fitter residents.
5. The use of innovative solutions, such as using animal interventions and new technologies (eg, robots), should be encouraged in order to increase residents' motivation and pleasure and, then, overall activity levels.	5. Duration. 35-45 minutes per session. Lesser durations may be needed during the first weeks of exercise. Longer sessions are feasible for most people.

*Capable of ambulating/rising from a chair with or without human assistance.

prevention of non-communicable diseases) (13, 14). Due to its specificities (functional limitations, multimorbidity), the exercise-related objectives for LTCF residents understandably focus more on the maintenance of functional ability and improvements in quality of life than the primary prevention of non-communicable diseases. Therefore, the current physical activity guidelines for older adults are certainly more appropriated for healthy community-dwelling older adults than to very old and vulnerable institutionalized elderly.

The present article reports on the results of a taskforce held in Toulouse, France, on December 1st 2015, prior to the Nursing Home Research International Working Group Conference (Toulouse, 2 and 3 December, 2015), under the auspices of The International Association of Gerontology and Geriatrics – Global Aging Research Network (IAGG-GARN) and the IAGG European Region Clinical Section. The main objectives of this taskforce, which involved experts from the broad fields of geriatrics, particularly nursing home care, and exercise and sports sciences, particularly physiotherapy and exercise for geriatric populations, were to define strategies to increase physical activity and to establish exercise guidelines for people living in LTCFs. Scientific evidence and feasibility issues for the implementation of physical activity strategies and exercise interventions in a long-term basis in LTCFs were the main pillars for the elaboration of the guidelines reported hereafter.

Healthcare issues in long-term care facilities and potential exercise benefits

Beside ADL dependency, LTCF residents face other important medical challenges. Dementia care, behavioral and psychological symptoms of dementia (BPSD), falls, malnutrition, pain, the use of potentially harmful drugs (eg, antipsychotics), and mood (particularly depression), severe sedentarity (bed- and chair-rest) and quality of life are often recognized by LTCF staff and experts as crucial issues for the care of residents (15, 16).

Exercise training has the potential to improve many of the above mentioned issues.

ADL performance. The most robust information about the positive effects of exercise for people in LTCFs comes from the review and meta-analysis of randomized controlled trials (RCT) from the Cochrane Group (10). In this review, Crocker et al. (10) have found that exercisers had better ability to perform ADL (as measured by the Barthel index or by the Rivermead mobility index) than controls; when pooling the results of all RCTs regardless of the tools used to measure ADL, Crocker et al. (11) found a positive effect of exercise (SMD 0.24, 95% CI 0.11-0.38; p = 0.0005; 13 studies, 2,363 participants), roughly

Table 1
Current physical activity guidelines for older adults (12, 13)

Minimum recommendations of physical activity for adults 65 years and over	
Recommendation from the American College of Sports Medicine and the American Heart Association (2007)[a]	*Recommendation from the World Health Organization (2010)[b]*
Aerobic/endurance (bouts of > 10 minutes). moderate-intensity aerobic PA, 30 minutes, five days/week or vigorous-intensity aerobic PA, 20 minutes, three days/week. These moderate- or vigorous PAs are in addition to the light intensity activities performed in daily life (e.g., self-care) or moderate-intensity PAs lasting 10 min or less.	Aerobic/endurance (bouts of ≥ 10 minutes). moderate-intensity aerobic PA, ≥ 150 minutes/week or vigorous-intensity aerobic PA, ≥ 75 minutes/week
+	+
Strength. 8–10 exercises, 10–15 repetitions, for strengthening the major muscles of the body, ≥ twice/week, moderate to high intensity	Strength. ≥ twice/week, muscle-strengthening involving major muscle groups
+	+
Flexibility. ≥ twice/week, 10 minutes.	Balance/coordination. "To reduce risk of injury from falls, community-dwelling older adults with substantial risk of falls should perform exercises that maintain or improve balance." (12)
+	
Balance/coordination. ≥ three days/week, for older adults with poor mobility in order to enhance balance and prevent falls.	

a. Adapted from: Nelson ME, Rejeski WJ, Blair SN, et al. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc. 2007;39(8):1435-45; b. Adapetd from: World Health Organization. Global recommendations on physical activity for health. 2010. WHO Press; Geneva, Switzerland.

corresponding to an increase of 1.3 points on the Barthel Index 20-point scale; such improvement means, for example, that a person who was dependent on bathing became independent.

Dementia care and cognitive function. Recent systematic reviews suggest that exercise is of benefit for the mobility and physical function of people with dementia (17, 18). Forbes et al. (17), in a meta-analysis of RCTs on exercise for people with dementia, found that exercisers had better ADL than controls (SMD 0.68, 95% CI 0.08 to 1.27, p=0.03; six trials, 289 participants), even though the authors judged this result as of low quality (due to inconsistency and imprecision). Although Forbes et al.'s study was not restricted to LTCF residents, the large majority of the included trials were performed among institutionalized older adults (only 2 out of 17 RCTs were developed among community-dwellers). Mixed results have been found for a potential positive impact of exercise on cognitive function in LTCF residents (10, 17, 18) with no clear and robust conclusions established currently.

Behavioral and Psychological Symptoms of Dementia (BPSD) and depression. Very recent findings from a meta-analysis of RCTs on exercise for treating BPSD in people with dementia did not find a statistically significant effect of exercise on the global levels of BPSD (19). However, the authors found a positive effect of exercise on depressive symptoms, including when restricting analysis to people living in LTCFs (SMD -0.323 (-0.628 to -0.018), p=0.038; six trials, 427 participants); exploratory analysis showed that exercise significantly reduced aberrant motor behavior and provided promising results (not statistically significant) for reducing apathy, agitation, and eating disorders. Although that meta-analysis found a significant effect of exercise on depressive symptoms for people with dementia in LTCFs, the literature on this topic is still mixed. Indeed, while some RCTs in LTCF found that exercise has reduced depressive symptoms (20-22) others found no effect (23-28), and one study showed that exercise increased depressive levels in a subpopulation of people with impaired cognition (29). One of the largest RCTs of exercise designed to reduce depression in residents of care homes (30) found that the intervention (twice/week, 45 minutes, physiotherapist-led group exercise sessions plus a whole home component designed to encourage more physical activity in daily life) was not effective in reducing both depressive symptoms and clinical depression in a 1-year interval; it is important to highlight that participants' compliance in this study was low (around 50% of exercise sessions, which means that participants really performed exercises in average only once a week).

Falls. Evidence for falls prevention in LTCF through exercise is still mixed. The meta-analysis of RCTs by Cameron and colleagues (31) found no significant effect of exercise (8 RCTs, 1844 participants) on both the rate of falls and the number of fallers. Although the authors suggested that exercise appeared to reduce falls in less frail individuals and to increase falls in frailer people, these results were not significant and were obtained after performing subgroup analysis in a low number of studies (four RCTs for each of "less frail" and "frailer"). Although it is not possible to crudely translate the findings obtained in other populations/settings to the LTCF

population, the results of a meta-analysis of RCTs on falls in community-dwelling older adults (32), which included many more RCTs (59 exercise RCTs, 13,264 randomized participants) than the study by Cameron et al. (31), found that multicomponent exercise (a combination of two exercise types or more among: balance/functional training, strength, endurance, flexibility, 3D, general physical activity, or others) reduced both the rate of falls and the risk of falling. Moreover, this study (32) and another meta-analysis of RCTs on fall-induced injuries in older community-dwellers (33), showed that exercise decreased the risk of fractures and injurious falls (including severely injurious falls). Similarly, a review (34) of exercise RCTs in older adults with physical frailty, a very common condition in LTCFs (35, 36) showed that seven out of 10 studies investigating the effects of exercise on incident falls found low rates of falls among exercisers compared to controls.

Quality of life. Evidence for quality of life is very sparse (37) with mixed results across RCTs in the institutionalized elderly. Whereas Lee et al. (38) found improvements in health-related quality of life (both physical and mental components) in a Tai Chi group and Mihalko et al. (39) showed improvements in life satisfaction in a strength exercise group compared to controls, Kerse et al., (29) McMurdo et al. (22) and Conradsson et al. (40) obtained no differences between exercisers and controls after the exercise intervention, although this latter found a positive effect of exercise on subjective well-being in the subgroup of people with dementia at 3-month; Chin A Paw et al. (23) found slight reductions in quality of life among exercisers compared to controls. Although on the basis of the scientific evidence currently available it is impossible to draw any solid conclusions, the positive impact of exercise on key health aspects for older populations, such as improvements on functional ability (10), physical function (including the ability to walk) (10, 41) and depression (19, 42) suggests that exercise should improve quality of life in older people in LTCFs.

Bed- and chair-rest and Sarcopenia. Bed- and chair-rest are important issues in LTCFs, with residents spending around 75% of their waking time in sedentary activities (43, 44). The use of both psychotropic drugs and physical restraints contribute to the high levels of physical inactivity in LTCF residents. Bed- and chair-rest may lead to muscle disuse, which, in turn, increases the risk of sarcopenia (45, 46). Exercise may contribute to decreasing the risk of sarcopenia, which is very prevalent in the institutionalized elderly (47-50). Indeed, since sarcopenia is defined by low muscle mass and low muscle strength/functional impairment (47-51), exercise could decrease sarcopenia in LTCFs by improving muscle strength and overall physical function. Exercise is a well-known powerful intervention for improving strength and physical function in older adults (52) including those living in LTCFs (10). For instance, Crocker et al. (10) showed positive effects of exercise on gait speed in LTCF residents; moreover, most RCTs included in Crocker et al.'s meta-analysis (10) have found positive effects of exercise on strength, particularly in the lower body. Although it is unlikely that exercise alone has positive effects on anorexia, weight loss, or the overall nutritional status of residents, all of them being common clinical conditions in LTCFs that lead to or increase the severity of sarcopenia, some evidence supports the conclusion that exercise plus nutritional supplementation improves the nutritional status of frail older adults (53).

Drugs. Data on the impact of exercise in decreasing the use of harmful drugs, such as antipsychotics, is almost non-existent. In the meta-analysis by de Souto Barreto et al., (19) only four RCTs (three of them in LTCF) out of 20 reported data on changes in antipsychotic use, with no changes in three of them, and mixed results in a fourth RCT; (40) none of the four RCTs reported data on the doses of antipsychotics. In a small RCT, Landi et al. (54) showed that exercise training reduced the use of antipsychotics and hypnotics in cognitively impaired people.

Beside its importance in the treatment/prevention of some of the clinical issues above mentioned, exercise is a recommended intervention for the treatment of several diseases that are prevalent in LTCF residents (55, 56) such as hypertension (57), heart diseases (58, 59) osteoarthritis, (60) osteoporosis (61, 62), diabetes (63), and stroke (64).

In sum, the current evidence clearly shows that exercise delays age-related declines in the ability to perform ADLs and improves physical function in older people living in LTCFs. Although exercise has the potential to improve other health outcomes in this population, such as falls, quality of life, BPSD and depression, the results of RCTs have been mixed and the findings are, therefore, still inconsistent.

Physical activity and exercise recommendations for subgroups of the LTCF population

Exercise may improve the health and daily care of institutionalized older populations. However, older adults living in LTCFs constitute a heterogeneous population. In terms of functional ability, residents may transition from independent living, to assisted living, and finally into skilled nursing care. Similarly for cognitive functioning, residents often transition from intact cognitive function, to mild cognitive impairment, and to dementia with various degrees of severity (from mild to severe dementia). This heterogeneity suggests that a single exercise prescription is unlikely to fit the desires and needs of all LTCF residents.

Taskforce members decided, therefore, to organize their recommendations in two different levels: a first-level of recommendations aiming at reducing sedentary behaviors for all LTCF residents and a second-level set of recommendations that aims to establish relatively specific, evidence-based guidelines for exercise training for well-defined subgroups of LTCF residents.

Improving overall daily life levels of activity among all LTCF residents: first-level of recommendations

Although, to the best of our knowledge, no data is available on the negative role of sedentary behaviors for the health of LTCF residents, limited evidence from community-dwellers suggests that sedentary time (ie, waking time spent in activities that did not increase energy expenditure over 1.5 metabolic equivalents (65), such as watching TV) is associated with adverse health outcomes, including the incidence of both type 2 diabetes and cardiovascular disease, and mortality (66-68). Interestingly, the associations between sedentary time and adverse health events are independent of subjects' physical activity levels. In a meta-analysis, Chau et al. (68) found a 34% higher mortality risk for adults sitting 10 h/day. Since LTCF residents spent around 75% of their waking time (43, 44) or more than 12hrs/day (69) in sedentary activities, they constitute a target population that might benefit from interventions designed to reduce sedentary time (70).

The increase of daily life activity levels in LTCFs is related to the reduction of sedentary time. In the LTCF setting, it is probably feasible and appropriate to elaborate strategies aiming at reducing sitting time through an increase in light physical activities (71). For example, Slaughter and Estabrooks (72), in a preliminary, quasi-experimental study showed that asking LTCF residents to stand up and sit down as many times as possible once in the morning and once in the evening improved residents' functional fitness as measured by the 30-seconds chair rise test.

Motivation and pleasure are the key aspects to take into account when attempting to increase overall activity levels in such a population, in whom ADL disability and cognitive impairment are common. To increase residents' motivation, it is important to build awareness of the importance of replacing sedentary time with physically demanding activities, even if those activities are of light-intensity (eg, walking slowly, light gardening), and LTCF staff should promote residents' physical engagement during social and daily life activities. Building awareness should target both the older residents themselves as well as LTCF staff, other healthcare professionals (including the primary care physician), residents' family, and policy makers. To increase motivation and impact overall activity levels the needs of both residents and LTCF staff must be assessed. This assessment of needs will permit LTCF staff to understand potential motivators and barriers to increasing resident activity levels, as well as insight into some of the motivators and barriers related to LTCF staff implementing the appropriate intervention strategies (73, 74).

Proposed recommendations to increase overall activity levels

Although there are no evidence-based guidelines for reducing sedentary time in LTCF settings, taskforce members recognize the crucial importance of enhancing the overall levels of activity in the daily life of residents. LTCF staff leadership should consider:

1) To adopt strategies for breaking the sedentary time of LTCF residents. Establishing short breaks (2-5 minutes) twice or three times a day is probably feasible in the LTCF setting.

2) To systematically use simple strategies to stimulate residents to move: walking to the lunch/dining hall rather than using wheelchairs for people who are able to ambulate, and organizing events that require residents going out from their rooms.

3) To avoid chemical and physical restraints as much as possible since they result in bed and chair-rest.

4) To optimize the utilization of the LTCF architecture and equipment in order to promote mobility.

5) Physical or occupational therapists, or another member of the staff, should organize group activities that are motivating and pleasant. Establishing groups to look after the garden, promoting dancing (75), or organizing walks in green spaces (76) around the LTCF, are examples of potential group activities that can be implemented. Group activities must take into account social affinities among residents, but also residents' interests and preferences to define the most suitable activities to implement.

6) To use innovative solutions, such as using animal interventions and new technologies, in order to increase residents' motivation and pleasure and, then, overall activity levels. Animal interventions have been shown to be effective in increasing physical activity in institutionalized older adults (77). The use of robots for the institutionalized elderly has shown to decrease feelings of loneliness (78) and improve participation in activities (79). Robots and other technologies (eg, emotional virtual interfaces) have the potential to increase residents' motivation for undertaking (light-intensity) physically demanding activities.

Evidence-based exercise guidelines for a subgroup of dependent LTCF residents: second-level of recommendations

Health professionals previously tried to propose some guidance on exercise for LTCF residents (37). However, there is no clear, well-established evidence-based guidelines on exercise for institutionalized older adults currently.

In order to identify the relevant information for debating on the best exercise regimen in LTCF, we decided to focus our critical analysis on ADL disability. Indeed, ADL disability is a major issue for the care of institutionalized older people due to its high prevalence in LTCF (15, 80, 81), its economic burden (3, 4) and its negative repercussion on residents' quality of life (82). Moreover, the most robust evidence on the health benefits of exercise for older adults in LTCFs regards its positive impact on ADL function (10).

Procedures

We selected relevant exercise RCTs by proceeding as follows: from the most recent review and meta-analysis of RCTs and cluster-RCTs of exercise for people in LTCF by Crocker and colleagues, (10) we identified the RCTs that met two eligibility criteria: 1) had assessed the ability to perform ADLs and 2) used an active exercise intervention; studies of whole-body vibration and staff educational interventions, if not coupled with an exercise training, were not examined. Then, we extracted data from the original RCTs on exercise type, frequency, intensity, session duration, intervention length, and compliance regarding exercise frequency, as well as on the effects of the intervention on ADL performance. To obtain a value that represents the real frequency of exercise practiced by participants, we multiplied compliance rates by exercise frequency and divided it by 100; data on the real frequency are considered when elaborating the exercise recommendations. We additionally examined the articles classified by Crocker et al. (10) as "awaiting assessment" and that were not included in their review. Since Crocker et al (10) have performed their last electronic search on August 2011, we performed an updated search from August 2011 to present (searches were performed on October 13th 2015) using simple key-terms (see Supplementary materials) in PubMed, the Cochrane Central Register of Controlled Trials, SportDiscus, and PsychInfo databases. This electronic search was intended to incorporate recent RCTs that have investigated the effects of exercise on the ability to perform ADL in the LTCF setting; a comprehensive systematic review intending to update Crocker at al.'s study (10) was out of the scope of this taskforce. Although examining all RCTs that met the eligibility criteria, we focused our critical analysis on RCTs that found positive effects of exercise on ADL performance, particularly those with more than 100 participants. The rationale for this procedure is related to the fact that Crocker et al. (11) found that larger RCTs had more conservative results (maybe more realistic results) on the benefits of exercise on the ability to perform ADLs.

After those search procedures, we obtained 32 RCTs that have investigated the effects of exercise on ADL performance in LTCF residents; taskforce members added another exercise RCT meeting the eligibility criteria. Almost all 33 RCTs used measures of functional ability as eligibility criteria for the selection of the study population. Ability to ambulate a few meters (with or without human assistance, according to the study) or ability to rise from a chair (without human assistance, with the assistance of one or even two caregivers, according to the study) were frequent eligibility criteria as well as dependency in basic ADLs (one, two or even more ADLs); therefore, the older LTCF residents participating in those RCTs were dependent in one or several basic ADLs, but were able to ambulate a few meters and/or to rise from a chair. The baseline levels of functional ability of participants in the exercise group in those 33 RCTs can be characterized by an average Barthel index of 68 out of 100 (n=6 studies; (24, 84, 87, 103, 106, 109) varying from 34 to 89.6) or 11.9 out of 20 (n=7 studies; (40, 85, 100-102, 105, 108) varying from 10.1 to 16.1), a functional independence measure (FIM) of 78.1 out of 126 (n=5 studies; (24, 83, 95, 97, 99) varying from 48 to 114.7), or a Rivermead mobility index (RMI) of 5.7 out of 15 (n=4 studies; (85, 100-102) varying from 4.9 to 6.1); for all those measurements, higher scores are better. Regarding cognition, participants of those trials had varied levels of cognitive function, transitioning from intact cognition to severe dementia; at least four studies (84, 86, 87, 96) excluded people with dementia and at least other four studies (28, 103, 107, 109) included only people with dementia. Most studies had participants with some degree of cognitive decline. The baseline mini-mental state examination (MMSE) score for the exercise group was, in average, < 24 in all (24, 25, 27, 28, 40, 83, 85, 92, 95, 98, 102, 103, 107-109) but one study (93) that used this assessment tool; the mean MMSE varied from 6.1 (85) to 25 (93) across studies.

Table 2 shows the characteristics of the 33 studies and their exercise interventions. The most represented countries were the US (n=7), the UK (n=4), and France, Spain and the Netherlands (n=3 each). Mean values for the number of study participants was 135.8, mean aged in average 82.5 years, 74.7% being women. The average exercise program (information for the two exercise groups in Deschamps et al. (92) and Faber et al. (93) and for the three exercise groups in Chin A Paw et al. (23) were combined) lasted around 16.4 weeks, with a weekly frequency of 2.9 sessions (the «daily» frequency of Kerse et al. (29) was replaced by 5), a compliance rate of 83.2% (n=22 RCTs), and a session duration of 42 minutes; real frequency performed (frequency X compliance/100) was 2.3 times/week. The main type of exercise was by far a moderate-intensity multicomponent training (a combination of two or more exercise types, such as balance, strength, aerobic, flexibility); the exercise types used across studies were strength (n=25), balance/coordination (n=17), aerobic/cardiorespiratory endurance (n=16), and flexibility (n=15). None of the trials reported major adverse events (death, important cardiovascular events (eg, heart attack), severely injurious falls, or fractures) related to the exercise intervention; at least two studies (27, 28) reported that exercisers fell more than controls, but this difference did not reach statistical significance in any of the trials. It must be, however, highlighted that not all studies clearly reported adverse events.

Fifteen RCTs found a positive effect of exercise on measures of ADL performance (studies italicized in Table 2). The characteristics of these RCTs were similar to those described for the whole sample: the average number of study participants was 124.5, aged 82.8 years, 73.4% women. The average exercise program lasted almost 24 weeks, with a weekly frequency of 3.1 sessions, a compliance rate of 81.7% (n=12 RCTs), and a session duration of about 48 minutes; real frequency performed was 2.5 times/week. The main type of

Table 2

Study characteristics and exercise interventions. Studies showing a positive effect of exercise, compared to controls, on ADL performance (global scores or scores of validated subscales) are italicized

Study population						Exercise intervention						
Study	**Country**	**n**	**Agea**	**Sex (% fem.)b**	**ADL measure**	**Length (week)c**	**Frequency (weekly)d**	**Complianced**	**Session duration (min)d**	**Intensitye**	**Type**	**Control Group**
Baum 200383	USA	21	88	75	PPT	25.8	3	80	60	Moderatee	Multicomponent (strength + flexibility)	Social activities
Benavent-Caballer 201484	Spain	89	83.9	65.1	Barthel index	16	3	100	32.5	Light	Strength training	Usual care
Brill 199821	USA	16	82	87	ADL score (eg, dressing, transferring)	8	3	93	30	Light-to-moderatee	Strength training	Light exercise
Brittle 200985	UK	56	84.5	71	RMI	5	2	42.5	50	Light-to-moderate	Multicomponent (balance/coordination + strength + flexibility + aerobic)	Usual care
Cadore 201486	Spain	32	91.7		Barthel index	12	2	90	40	Moderate	Multicomponent (high-speed strength training (for muscle power) + balance/coordination + flexibility)	Light exercise
Chen 201587	Taiwan	127	79.1	49.1	Barthel index	25.8	3	94.5	40	Unclear	Multicomponent (strength + flexibility + aerobics)	Usual care
Chin A Paw 200423/Chin A Paw 200688	Netherlands	224	81.1	80.2	ADL score (17 activities)	24	2	73g	52.5	Moderate-to-high	Multicomponent (three exercise groups. Strength: strength + stretching; Functional: functional activities + stretching; Combined: a combination of the other two exercise groups)	Social activities
Conradsson 201040 / Rosendahl 200689 / Littbrand 200690 / Littbrand 200991	Sweden	191	84.7	73	Barthel index	13	2.2	72.2	45	Moderate-to-high	Multicomponent (balance/coordination + strength + functional training)	Social activities
Deschamps 201092	France	160	82.3	71.7	Katz ADL index	26	4 TC 2 CA	38.8 TC 48.9 CA	30 TC 35 CA	Light-to-moderate	Multicomponent (TC: Tai chi + muscle reinforcement; CA: balance + strength + flexibility)	Social activities
Dorner 200724	Austria	42	86.8	77	Barthel index and FIM	10	3	91.8	50	Unclear	Multiomponent (balance/coordination + strength)	Active control
Faber 200693	Netherlands	278	84.9	79	GARS	20	2	88 FW 84 IB	60	Moderate	Multicomponent (IB: adapted Tai Chi + balance; FW: functional training + balance)	Usual care
Gallon 201194	Brazil	19	67	100	Barthel index	8	3			Lighte	Flexibility	Social activities
Grönstedt 201395	SwedenDenmark Norway	322	85	73.5	FIM	12	4		29.25	Unclear	Multicomponent (balance/coordination + strength + aerobic + functional training)	Usual care
Hsu 201196	Canada	44	80	71	NHPPT	4f	3	92h	20h	Moderatee	Multicomponent (balance/coordination + strength) + Wii (bowling)	Multicomponent exercise
Kerse 200829	New Zealand	682	84.3	74	LLFDI	25.8	Daily			Unclear	Functional training (physical activities based on repetitions of activities of daily living, such as rising from a chair,	
Lazowski 199997	Canada	96	80	84	FIM	17.2	3	86	45	Moderatee	Multicomponent (balance/coordination + strength + aerobic + flexibility)	Flexibility
Lorenz 201298	USA	193	81	64.7	NHPPT	7	5	81	28.4	High	Multicomponent (strength + aerobic)	Usual care
Makita 200699	Japan	149	85	100	FIM	12.9	3			Unclear	Multicomponent (balance/coordination + strength + aerobic)	Unclear
McMurdo 199322	Scotland	49	81	80	Barthel Index	30.1	2	91	45	Light	Multicomponent (strength + flexibility)	Social activities
Meuleman 200025	USA	78	75	12	PADL	6	5		30	Moderate	Multicomponent (strength + aerobic)	Usual care

Table 2 continued

		Study population				Exercise intervention						
Study	**Country**	**n**	**Agea**	**Sex (% fem.)b**	**ADL measure**	**Length (week)c**	**Frequency (weekly)d**	**Complianced**	**Session duration (min)d**	**Intensitye**	**Type**	**Control Group**
Rolland 200728	France	134	83	75	Katz ADL	52	2	33	60	Moderate	Multicomponent (balance/coordination + strength + flexibility + aerobic)	Usual care
Sackley 2006100	UK	118	87	82	RMI and Barthel Index	12	0.28j		30	Unclear	Multicomponent (flexibility + aerobic + functional training)	Usual care
Sackley 2008i101	UK	34	86	88	RMI	4	2		60	Unclear	Multicomponent (balance/coordination + strength + flexibility + aerobic + functional training)	Usual care
Sackley 2009102	UK	249	85	74	RMI and Barthel Index	12.9	1.25j		21.5	Moderatee	Multicomponent (balance/coordination + strength + flexibility + aerobic + functional training)	Usual care
Santana-Sosa 2008103	Spain	16	74.5	38	Katz ADL and Barthel Index	12	3	98.9	75	Light	Multicomponent (balance/coordination + strength + flexibility)	Usual care
Seynnes 2004104	France	27	81.5		Disability index	10	3	99	8	High and light (two exercise groups)	Strength training	Placebo
Tak 2012105	Netherlands	192	84.6	100	PPT	22	1		30	Light	Multicomponent (aerobic + functional training)	Usual care
Takeuchi 2011106	Japan	28	85.7	85.7	Barthel index	4	2	100	20	Light	Multicomponent (balance/coordination + strength + aerobic)	Multicomponent without aerobics (walking)
Tappen 1994107	USA	72	84	75	Physical Self-Maintenance Scale and PADL	20	5		150	Unclear	Functional training	Usual care
Tsaih 2012108	Taiwan	59	76.9	60	Barthel index	4	3	100	37.5	Light	Multicomponent (balance/coordination + aerobic + functional training)	Usual care
Venturelli 2011109	Italy	24	84	100	Barthel index and PPT	24	4	93.4	30	Moderate	Walking	Usual care

Note. ADL, activities of daily living; CA, cognition-action group; FIM, functional independence measure; FW, functional walking group; GARS, Groningen Activity Restriction Scale; IB, in balance group; LLFDI, Late Life Function and Disability Instrument; MDS, minimum data set; NHPPT, Nursing Home Physical Performance Test; PADL, Physical Activities of Daily Living; PPT, physical performance test; RMI, Rivermead Mobility Index; TC, Tai Chi; a. When participants' age was provided separately by group, we added all ages and divided by the number of study groups to obtain a mean age; b If % of female provided separately by group, we added all % of female and divided by the number of study groups to obtain a mean. Sex may also have been calculated from the absolute number of males and females in the studies; c. If intervention length was provided in months, we then multiplied the months by 4.3 to obtain «weeks»; d. If this information was provided as a range, we calculated a mean by adding upper and lower limits and dividing by two; e. In those studies, intensity was not clearly described by the authors. When possible, we defined the intensity from "cues" provided by the authors. For example, in the study by Baum 2003 rated as moderate: «Each exercise was begun with one set of 5 repetitions and gradually progressed to two sets of 10 as tolerated. Participants were evaluated weekly for the quality of their movement and number of repetitions with good technique to determine progression of soft weights, balls, or resistance of the therabands.»; f. Before the crossing over of the interventions; g. Information on the 3 exercise groups (strength training, functional training, and a combination of strength and functional training) were combined because none of these groups improved ADL function compared to controls. This allowed us to obtain a mean value for the three groups; h. Information regards only the Wii part of the intervention; i. Although the «mean mobility scores (as measured by the Rivermead Mobility Index) declined in the control group (n:16; baseline: 5.9, six weeks: 4.75) when compared to the intervention group (n:17;baseline: 6.1, six weeks: 6.2)», the authors did not present any formal statistical analysis; j. The exact weekly frequency was not provided, but the authors reported the total exposure (number of visits and total duration). From this, we calculated average weekly frequency and session duration

exercise was by far a moderate-intensity multicomponent training; the exercise types more used across studies were strength (n=12), aerobic/cardiorespiratory endurance (n=8), flexibility (n=9), and balance/coordination (n=6). Focusing on the seven RCTs in which the exercise intervention was found to improve ADL function and that had more than 100 participants, we obtained the following results: the mean number of study participants was 209, aged around 82 years, 72.9% women. The average exercise program lasted almost 27 weeks, with a weekly frequency of 3.1, a compliance rate of 68% (n=5 RCTs), and a session duration of 34 minutes; real frequency performed was 2.3 times/week. The main type of exercise was a moderate-intensity multicomponent training (all seven studies used a multicomponent training); the exercise types more used across studies were strength (n=6), aerobic/cardiorespiratory endurance (n=6), flexibility (n=4), and balance/coordination (n=3).

Proposed guidelines for exercise training

The evidence shows that a moderate-intensity multicomponent training program, composed of strength and aerobic exercises, is effective for improving ADL performance in older adults living in LTCFs; additional benefits may be achieved by integrating balance/coordination and flexibility exercises to the multicomponent training. The guidelines proposed below should be applied for institutionalized older adults who are dependent in basic ADLs, but still able to ambulate and/or to rise from a chair (with or without human assistance), including people who had cognitive decline and even dementia; indeed, the evidence used to build these guidelines was extracted from populations with such characteristics, as described above. Moreover, these recommendations should be applied for overall stable patients. Patients in the end-of-life, bed-bound, or with any unstable conditions precluding exercise should be examined on a case-by-case basis and should have a more personalized intervention, if appropriate. In order to be effective in a long-term basis, the exercise program must be continuously adapted to individuals' capacity and must be organized as a progressive challenge. Residents should be stimulated to comply with these guidelines and clear strategies to «re-engage» those who quit exercise classes should be defined by the LTCF staff leadership.

The taskforce group makes the following recommendations as the minimum exercise training to be provided for this subgroup of LTCF residents:

Exercise type. Multicomponent training. Exercises designed for improving muscle strength and cardiorespiratory endurance must be the essential part of the multicomponent training. Strength training may be performed through weight-bearing exercises and using free weights (the use of machines is less usual in the LTCF setting, even though it is feasible). . Special attention must be done to strengthening the lower-body. The aerobic aspect may traditionally be implemented through walking (in continuum or by walk bouts); using circuit training, with walk bouts interposed between other types of exercises, may also contribute to achieve aerobic endurance. Other exercise types, particularly flexibility and balance, should be added to the exercise program whenever possible. For example, active range-of-motion exercises may be integrated in the warm-up phase, while stretching may be part of the cool down phase of the training. In order to increase strength and, then, self-confidence and mastery, several sessions of strength training may be needed before introducing balance/coordination activities, particularly for very vulnerable people. Specific exercises may be integrated in order to train people for the execution of actions that are strongly associated with falls, particularly standing quietly, sitting down or lowering, and initiation of walking (110); adding a component of muscle power (prioritizing the speed of muscle contraction) may be integrated in such an exercise training. Walking forward with direction changes may also contribute to reduce falls, since walking forward is the most common activity at the moment of fall (110).

Intensity. Moderate. Moderate-intensity can be achieved in the following ways for the different types of exercise:

Strength. One or two sets of exercises, performed at 13-15 repetitions maximum. The number of exercises will be limited by time availability and residents' exercise capacity; the ideal number of exercises would be of 8-10. Low-intensity exercises performed at up to 20 repetitions maximum may be required, particularly in the first weeks of the exercise program. High-intensity exercise, ie, exercises performed at 8-12 repetitions maximum, can be executed, but it may require a closer monitoring (90).

Aerobic endurance. Through exercises that noticeably increase heart rate and respiration, without generating breathlessness or undue fatigue. It can be easily monitored through self-report as recommended by ACSM/AHA: «On a 10-point scale, where sitting is 0 and all-out effort is 10, moderate-intensity activity is a 5 or 6 and produces noticeable increases in heart rate and breathing» (13). Attention must be paid for people with important cognitive impairment, who are unable to identify moderate intensity and to communicate potential acute signs, such as pain. Light-intensity exercises appear to provide some benefits and should be envisaged for very vulnerable people and at the start of any exercise program (during the first weeks of exercise). High-intensity exercise can be performed, but it may require a closer monitoring; on the same self-reported scale as above, «vigorous-intensity activity is a 7 or 8 and produces large increases in heart rate and breathing» (13).

Flexibility. Active range-of-motion and stretch exercises should be performed during 10-30 seconds per exercise; the number of exercises will be limited by time constraints. Although assessing the intensity of flexibility exercises is very difficult, asking residents to perform range-of-motion and

stretching exercises to the maximum of their capacity without reaching painful levels is probably feasible and safe. Attention must be paid to people who are unable to communicate painful feelings.

Balance. Establishing the intensity of balance exercises is a challenge since there are no validated instruments developed to this purpose (111). A progressive increase in the difficulty for executing static (eg, semi-tandem, tandem, single-leg stand), but mainly dynamic balance (eg, walking in the line, tandem walking in the line; walking with changing directions slowly and, then, faster) is required. Exercises that reduce sensory input (e.g., standing with eyes closed) (12) can also be used.

Frequency. Twice a week. Doing more than twice a week can be a difficult target for most LTCF residents, and doing less than that can be ineffective (88). An interval of at least 48hrs between sessions should be respected. An exercise program with three or more weekly sessions is, however, safe and may be feasible for fitter residents.

Duration. Between 35 and 45 minutes per session. This session duration range gives enough time for the essential components of the exercise training, ie, strength and aerobic training, and still leaves some time for other exercises, such as flexibility and balance. Lesser durations may be needed for very vulnerable people and during the first weeks of exercise. Longer sessions (preferentially, not longer than 60 minutes) are, however, feasible for most people.

A typical exercise session for older people in LTCFs

We provide below an example of how a 45-minute session of exercise could be divided:

- 4 minutes warm-up. Range-of-motion exercises (for example, for the wrists, shoulders, hip, knees, and ankles), followed by light walking;
- 8 minutes balance/coordination. Standing balance with increasing difficulty (eg, narrowing the base of support); activities of bodyweight shift; walking forward with changing directions; walking along a straight line (forward, backward, and sideward).
- 15 minutes strength. 13-15 repetitions maximum of chair rises, with increasing difficulty (eg, emphasizing speed of movement); different theraband exercises for the upper-body and trunk; calf weights for knee extension and flexion or weighted belts for functional lower-limb strength exercises.
- 15 minutes aerobic. Five 3-minute bouts of walking interposed between two strength exercises and/or between two balance/coordination exercises.
- 3 minutes calm down. Very light walking followed by a few stretching exercises.

Implementing the recommendations

To promote the implementation of the proposed recommendations in the real life of LTCFs, it is crucial to take into account residents' desires, preferences, beliefs and attitudes toward physical activities and exercises. For instance, taking into account subject's self-efficacy (ie, one's belief that he/she is capable of performing the goal-directed behaviour) to define challenging but feasible goals (with the resident whenever possible) are essential factors to consider when designing strategies to increase/maintain optimal levels of physical activity and exercise. Other important aspects for the successful implementation of the recommendations are related to promoting social support (eg, by doing physical activities and exercise in group), and providing a stimulating environment (eg, by using different equipment with different colors: free weights, balls, carpets with different consistencies, by using music during the exercise sessions, and even implementing dual-task training) for LTCF residents. Building awareness of residents' family members and primary healthcare providers about the importance of physical activity and exercise for older adults as well as about their role in keeping the resident physically active is a key aspect for the implementation of our recommendations.

Moreover, LTCF organizational aspects are as important as the recommendations themselves. Even though it is out of the scope of this taskforce to deeply debate about LTCF organizational aspects, taskforce members recognize that strategies that may favor a successful exercise implementation in LTCFs should be discussed in the facility and healthcare system levels. In the facility level, LTCF leadership staff may discuss and implement different strategies that include (but are not limited to): involving residents' family and primary health care provider in the "exercise strategy" to increase residents' adherence to exercise; adding exercise programs in the personalized healthcare plan of all residents who do not have any contraindication for exercising (every resident who has no contraindications must have a personalized exercise program); defining strategies for providing incentives to residents who exercise regularly, for example, by rewarding residents who increased or maintained high attendance rates in exercise sessions; defining an "exercise referent" person among LTCF staff, as it already exists for pain care; providing sufficient training to LTCF staff and volunteers in how to conduct exercise sessions. To optimize the potential health benefits of physical activity and exercise in LTCF residents, extra people in the LTCF is required. The training level in terms of knowledge and experience in physical activity of the extra people can vary from highly trained professionals to sufficiently trained volunteers. Although the ideal picture is that exercise training sessions in the LTCF should be led by professionals from the field of exercise sciences, and all efforts must be undertaken towards this ideal picture, an important number of facilities (maybe most of them) will not have the required resources for that; in those LTCFs, healthcare providers, other than exercise science professionals, and/or volunteers will be in charge of conducting exercise sessions, needing thus to achieve minimum levels of knowledge and

expertise on exercise.

In a transition level, which would ask for efforts from both facility and healthcare systems, strategies that build awareness about the potential role of LTCF as a site for healthcare prevention through exercise should be promoted; for example, by taking advantage of the already existing space and staff expertise in LTCFs, facilities may open its doors and invite the whole community to exercise in the LTCF, with LTCF residents. Other innovative solutions, such as integrating volunteers, including high-school or college students, into the strategies of the LTCF in order to increase both residents' daily life physical activity (eg. walking or gardening with volunteers) and their adherence to exercise sessions (eg, exercising with volunteers) should also be welcome; volunteer-led exercise interventions have already been tested and provided positive results on exercise adherence (participants completed in average 94% of the proposed volunteer-led sessions) and on clinical outcomes (eg, ADL performance) (112).

In the level of healthcare systems, policies that facilitate the implementation of exercise in the LTCF setting should be debated and implemented. For example, establishing the successful organization of exercise sessions in the LTCF (for example, by conducting exercises according to the guidelines proposed herein) as a quality indicator of care and/or creating a distinguished label ("LTCF fit-friendly") for LTCFs that organize exercise successfully, and defining ways to pay/reimburse the expenses related to the exercise program, would certainly help promoting exercise in LTCF.

Conclusions and Perspectives

Scientific evidence about the effects of physical activity and exercise on the health of older adults in LTCF has increased in the past decade. Establishing strategies to increase activity levels in daily life as well as minimal standards in terms of exercise regimen is important for the guidance of professionals working in this setting.

Taskforce members purposefully covered a very large spectrum of recommendations from overall strategies to increase physical activity levels in the daily life of LTCF residents to more precise guidelines on exercise training to a well-defined subgroup of LTCF residents. Our recommendations should not be used as a one-size-fits-all approach. Instead, they should be used as a flexible framework since the most appropriate strategies to increase residents' daily life physical activity will vary across facilities as well as the different parts of the exercise regimen (type, frequency, intensity, duration) should be adapted according to residents' capacities, needs and desires. It is important to highlight that, currently, LTCF residents appear to engage in less exercise than the recommendations proposed herein, as showed in an observational cross-sectional study in which only 10% of nursing home residents exercised at least twice a week (113).

In order to confirm that our recommendations in terms of overall physical activity and exercise training are appropriate and effective for institutionalized older adults, further studies are needed. Well-designed and large RCTs are particularly welcome to examine the effectiveness of the exercise recommendations on different relevant outcomes for LTCF residents, such as BPSD, falls, malnutrition, and quality of life, as well as on staff-related outcomes, such as reductions of staff burnout. Cost-effectiveness analysis is also required in order to strengthen our recommendations.

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Supplementary materials

Search strategy performed on October 13th 2015

PubMed

1 ((adl[Title/Abstract]) OR «activity of daily living»[Title/Abstract]) OR «activities of daily living»[Title/Abstract]

2 (((«nursing home»[Title/Abstract]) OR «nursing homes»[Title/Abstract]) OR «long-term care facility») OR «long-term care facilities»

3 (((exercis*[Title/Abstract]) OR «physical activity»[Title/Abstract]) OR «physical therapy»[Title/Abstract]) OR «physical rehabilitation»[Title/Abstract]

4 («2011/08/01»[Date - Publication] : «3000»[Date - Publication])

5«randomized controlled trial»[Publication Type]

61 AND 2 AND 3 AND 4 AND 5

Cochrane Central Register of Controlled Trials

ID Search

#1 adl:ti,ab,kw or «activity of daily living»:ti,ab,kw or «activities of daily living» in Trials (Word variations have been searched)

#2 adl:ti,ab,kw or «activity of daily living»:ti,ab,kw or «activities of daily living»:ti,ab,kw in Trials (Word variations have been searched) - 5.554

#3 «long-term care facility»:ti,ab,kw or «long-term care facilities»:ti,ab,kw or «nursing home»:ti,ab,kw or «nursing homes»:ti,ab,kw (Word variations have been searched) - 2.410

#4 exercis*:ti,ab,kw or «physical activity»:ti,ab,kw or «physical therapy»:ti,ab,kw or «physical rehabilitation»:ti,ab,kw (Word variations have been searched) - 53.746

#5 «randomised clinical trial»:pt or «randomised clinical trials»:pt or «randomised control trial»:pt or «randomised control trials»:pt and «randomised controlled clinical trial»:pt (Word variations have been searched)

#6 «randomised clinical trial»:pt or «randomised control trial»:pt or «randomised controlled clinical trial»:pt or «randomised controlled study»:pt or «randomised controlled trial»:pt (Word variations have been searched) - 355.544

#7 #2 and #3 and #4 and #6

SportDiscus

S4 S1 AND S2 AND S3

S3TI exercis* OR AB exercis* OR TI «physical activity» OR AB «physical activity» OR TI «physical therapy» OR AB «physical therapy» OR TI «physical rehabilitation» OR AB «physical rehabilitation»

S2 TI «nursing home» OR AB «nursing home» OR TI «nursing homes» OR AB «nursing homes» OR TI «long-term care facility» OR AB «long-term care facility» OR TI «long-term care facilities» OR AB «long-term care facilities»

S1 TI adl OR AB adl OR TI «activity of daily living» OR AB «activity of daily living» OR TI «activities of daily living» OR AB «activities of daily living»

PsychInfo

S4 S1 AND S2 AND S3

S3 TI exercis* OR AB exercis* OR TI «physical activity» OR AB «physical activity» OR TI «physical therapy» OR AB «physical therapy» OR TI «physical rehabilitation» OR AB «physical rehabilitation»

S2 TI «nursing home» OR AB «nursing home» OR TI «nursing homes» OR AB «nursing homes» OR TI «long-term care facility» OR AB «long-term care facility» OR TI «long-term care facilities» OR AB «long-term care facilities»

S1 TI adl OR AB adl OR TI «activity of daily living» OR AB «activity of daily living» OR TI «activities of daily living» OR AB «activities of daily living»