

Home-fitness and active ageing: A review

Alessandro Capriotti  . Department of Biomolecular Sciences. University of Urbino "Carlo Bo". Italy.

Valeria Patregnani. Department of Biomolecular Sciences. University of Urbino "Carlo Bo". Italy.



Ario Federici. Department of Biomolecular Sciences. University of Urbino "Carlo Bo". Italy.

ABSTRACT

The global aging of the population will lead to an increase in social and economic demands, so keeping the elderly active has become a priority. According to the WHO Guidelines, regular physical activity is essential for staying active and healthy and often the best opportunity to do this is at home. Strength activities are frequently set aside because they are considered useless or even risky, but on the contrary have great importance for maintaining of the physical well-being Home-Fitness is an excellent effective and accessible tool for everyone because it brings benefits on a physical and cognitive level, while staying at home. The objective to deepen all aspects related to physical exercise at home in ageing, through a systematic review of the scientific literature, investigating what are the evidence of greatest interest. The evidence determines in depth the relationship between physical activity at home and the elderly, concluding that, those who exercise regularly have a higher quality of life compared to less active subjects. The current COVID-19 pandemic should serve as an impetus for progress in this field.

Keywords: Frailty, Older adults, Ageing, Exercise, Prevention, Home-based.

Cite this article as:

Capriotti, A., Patregnani, V., & Federici, A. (2022). Home-fitness and active ageing: A review. *Scientific Journal of Sport and Performance*, 1(3), 167-178. <https://doi.org/10.55860/IJUS3216>



Corresponding author. Department of Biomolecular Sciences. University of Urbino "Carlo Bo." Italy.

E-mail: alessandro.capriotti@uniurb.it

Submitted for publication June 07, 2022.

Accepted for publication July 01, 2022.

Published September 22, 2022.

[Scientific Journal of Sport and Performance](#). ISSN 2794-0586.

©Asociación Española de Análisis del Rendimiento Deportivo. Alicante. Spain.

doi: <https://doi.org/10.55860/IJUS3216>

INTRODUCTION

The World Health Organization (WHO) confirms that from 2000 to 2019, global life expectancy, considering both men and women, increased by 5.5 years, from 66.5 to 72 years. By 2050 the elderly over 65 will exceed adolescents and young people between 15 and 24 years (United Nations, 2019) and constituting 31.3% of the population compared to 20.2% in 2019. (EUROSTAT)

As the WHO asserts: *“the global aging of the population will entail social and economic demands that will have to be met, so keeping the population active is a necessity and not a luxury”*. Active aging, defined by the WHO as *“a process of optimizing opportunities relating to health, participation and safety, with the aim of improving the quality of life of elderly people, becomes extremely important.”* To emphasize the importance of the theme, the *“Decade of Healthy Aging”* was inaugurated, that is the decade dedicated to healthy aging that will cover the period from 2020 to 2030.

The term aging refers to the loss of the body's ability to maintain its homeostasis, that is, the body is no longer able to respond and adapt to changes in the internal and external environment and to maintain its balance. This inefficiency leads to the appearance of modifications that in the long run end with the functional decay of the organism itself and consequently a programmed death. (Clegg, Young, Iliffe, Rikkert, & Rockwood, 2013) According to the definitions officially adopted to date, a person who has reached the age of 65 is considered elderly but the proposal that comes from the Italian Society of Geriatrics and Gerontology (SIGG) is to update the concept of seniority, bringing to 75 the ideal age to define a person as elderly, because *“individuals with the same chronological age vary widely in terms of health and function.”* (Mitnitski, Graham, Mogilner, & Rockwood, 2002)

If aging is a physiological condition, a sedentary lifestyle is not. Often the use of motor skills is progressively reduced, until a hypokinetic or even akinetic picture is reached. Scientific evidence reports that elderly people often do not engage in physical activity, not for physical problems, but for fear of failure, unawareness of the potential benefits related to movement and because they feel active even if they are not. (Costello, Kafchinski, Vrazel, & Sullivan, 2011) Physical activity is an indispensable means not only to counteract the negative effects of frailty and limit the loss of autonomy, but also to give motivation, self-esteem, psychological well-being and increase the perception of autonomy of the elderly. Professionals who work in old age must pay particular attention to the motivational aspect, but above all increase self-awareness and minimize the perceived risks associated with carrying out activities. (Franco, et al., 2015) (Baert, Gorus, Mets, & Bautmans, 2015) (Schutzer & Graves, 2004)

Inactivity has serious negative effects on health across the lifespan (Harridge & Lazarus, 2017) and to confirm the importance of movement for the elderly population, guidelines on physical activity have been defined by the WHO, according to which, in order to improve cardiorespiratory and muscular health and reduce the risk of chronic diseases and the cognitive decline, people over 65 should have at least 150 minutes per week of moderate-intensity aerobic physical activity or at least 75 minutes of vigorous-intensity aerobic physical activity or an equivalent combination of both (they can be accumulated, i.e. activities can be carried out for shorter periods of at least 10 minutes each). It is also recommended to combine strength exercises of the major muscle groups at least twice a week, also focusing on activities aimed at improving balance and preventing falls for at least 3 times a week. Strength activities are frequently set aside because they are considered useless or even risky, but on the contrary have great importance for maintaining of the physical well-being (Montero-Fernández & Serra-Rexach, 2013) and increasing life expectancy. (McLeod, Breen, Hamilton, & Philp, 2016) The professional who follows the user will have the task to understand which is the

point below which the exercise is not effective and above which one can incur injuries or put the health of the subject at risk. *“Isotonic contractions are preferable to isometric ones, especially for those who suffer from arterial hypertension and who would be negatively affected by carrying out work that brings a further increase in pressure, hindering the circulation.”* (Federici, Valentini, Tonini, & Cardinali, 2000)

For all those who cannot carry out the activities indicated above due to their health conditions, it is expected to constantly adopt an active lifestyle (e.g., prefer choices related to movement as to reach places of interest through walks rather than by means of transport and climbing stairs instead of using the elevator) by performing low intensity exercises and within the limits of one's ability: *“any type of movement is preferable to a sedentary lifestyle”* (Lee, Jackson, & Richardson, 2017). There are no contraindications if the activity is performed following specific criteria and indications and above all if the program is arranged and proposed in a different way for each individual subject.

The benefits that physical activity entails and how much it affects the overall well-being of the person have already been widely confirmed, but in recent years the practice of Home-Fitness is spreading to stay active. Just think of how today's market has paid particular attention to this area, creating a wide range of apps and platforms that allow you to train at home and, if you wish, to be followed or directed by experts, without the need to go out and go to the gym. Moreover, not only in certain cases it is a real necessity, but often the subjects prefer not to leave their home by choice. In this regard, the current COVID-19 pandemic should serve as an impetus for progress in this field, in fact *“it is urgent to develop innovative strategies to prevent functional decline among individuals at risk during periods of social detachment and quarantine, but many rural residents need this kind of services even under normal circumstances”*. (Middleton, Simpson, Bettger, & Bowden, 2020.)

Speaking of Home-Fitness we refer to interventions *“aimed at strengthening the motor function that the non-use has reduced to a minimum. The primary goal is to increase body and motor awareness, creating training programs suited to one's lifestyle and physiological needs.”* (Federici & Dardanillo, 2006) Therefore, linking ourselves to active aging, it is based on interventions focused on the individual and his abilities or *“the search for elements of well-being through activities related to a person's objectives, functional abilities and opportunities.”* (Rantanen & Saajanaho, 2018) Exercise carried out at home is an excellent tool to facilitate access to exercise and to avoid a sedentary lifestyle in the over 65, first of all, because home is considered the safest place where being able to better express oneself, away from comparison with others: the centre of the world for the elderly, who spend most of their time there (Barry, Heale, Pilon, & Lavoie, 2018), moreover, the awareness that is acquired leads to a better ability to reintroduce in society and participation, fighting *“isolation and loneliness which are particularly problematic aspects in old age.”* (Courtin & Knapp, 2015) *“Considering physical exercise as a real therapy and as a tool for reintegrating the person in their social context, gives it a double meaning”*. (Federici & Palanca, 2019)

Objective

Deepen all aspects related to physical exercise carried out at home in the Third Age, through a systematic review of the scientific literature, investigating what are the findings ascertained to date and the evidence of greatest interest relating to it.

METHODS

The analysis was carried out on the major known scientific search engines, including PubMed, Google Scholar, SportDiscuss. The search was conducted based on the title, and abstracts were then analysed to exclude studies and reviews not appropriate to the topic.

Out of the total number of scientific articles viewed, only 31 (studies and reviews) met the required inclusion criteria, namely:

- Activities at home or partially at home;
- Excluding studies where the activities promoted were aimed at post-operative patients or subjects affected by serious pathologies, which did not allow them to live and carry out exercises independently;
- Free consultation of full-text;
- Studies concerning adults over 60/65;
- No limits have been set regarding gender, language, nationality and duration.

Data collected

Studies and related reviews all report a publication date after the year 2000, except numbers 26 and 31. The studies evaluate more than 10'000 subjects. Studies number 13, 20, 24 and 29 evaluate subjects aged ≥ 60 , while the rest only look at ≥ 65 .

From the review it emerged that 11 studies focus on physical activity planning proposed to frail or pre-frail subjects; 3 studies for sedentary elderly; 5 studies for healthy elderly people without particular pathologies; 5 for people with limitations or not completely limiting pathologies (osteoarthritis, low bone mineral density, damage to the lower body and cancer survivors), therefore, all adults at high risk of developing more serious pathologies or of losing functionality; the remaining 7 aimed at subjects with an ascertained clinical history of falls.

The studies are generally of long duration: most of 6/12 months; 10 3-month activity studies (12 weeks); only 3 exercise groups exceed 18 months (for both exercise and control group). Exercise sessions are required in 14 programs 3 times a week; at least 3 times in 2 articles; 2 studies once a week of 60 minutes; 7 work plans at least 2 weekly sessions; 4 searches at least 5-7 days of activity; finally, 1 study for once a month. 3 study groups perform training sessions in specialized facilities as well as exercise sessions at home. The duration of the sessions was highly variable, it was not possible to establish an optimal duration.

As concerning the nutritional / food aspect, 10 articles prepare a nutritional plan or advice on nutrition and good habits, while the remaining 21 do not take this component into consideration.

What emerges from the review, at the level of the objectives pursued, allows us to state that the attention of scholars in the sector, to date, is mainly focused on preventing and maintaining functionality, independence and autonomy. In fact, 12 studies aim to improve functional abilities, quality of life and performance in general; 12 articles have as their main purpose the study of falls (frequency, severity of injuries and fear of falling), associated with prevention and programs of strength and proprioception of the lower limbs; finally, 7 examine functional capacities, aiming to ascertain their tendency, following a targeted exercise program. The exercise proposals cover a wide range, in order to preserve functionality, the ability to independently carry out daily life activities and improve physical performance in general (balance, strength, aerobic capacity, mobility, posture, flexibility, strength hand grasp or ability to concentrate and neuro-motor stimulation). We note that

no studio requires the purchase of equipment, in fact low-cost elastic bands, dumbbells or anklets are provided by the program managers. In most cases, the weight of the body or small tools is used, as required by the WHO guidelines.

The most used tool is the “*Otago Exercise Program*” (OEP), designed with the aim of reducing the number of falls, through strength exercises (especially of the lower limbs) and balance. This proposal was created to be usable in the over 65 age group at home. It involves 30 minutes of exercise 3 times a week with walking at least twice a week. We know that falls and related injuries are considered one of the biggest public health problems, also causing high social costs. (Martins, et al., 2018) Approximately 35% of people over 65 falls annually and this figure rises to 50% in those over 80, causing loss of confidence in their possibilities and loss of independence. (Thomas, Mackintosh, & Halbert, 2010) In addition to high social costs, 40% of all nursing home admissions have been found to be related to falls and instability. (Bjerk, Brovold, Skelton, & Bergland, 2017)

DISCUSSION

The review revealed interesting aspects regarding the over 65s and related to: adherence to exercise, choice of physical activity, study of frailty, prevention of falls and performance associated with functionality. The evidence confirms that active aging takes on extreme importance when we consider that the elderly seem to favour a better quality of life than longevity, that is, they prefer to live well even if for a shorter time. (Bjerk, Brovold, Skelton, & Bergland, 2017)

Systematic review suggest that home exercise interventions, which focus on progressively challenging balance and increasing strength, can reduce up to 42% of falls in those with a history of falls. (Gawler, et al., 2016) Despite the recognized benefits of physical activity, many still do not reach the WHO recommended amount of exercise target and poor adherence is related to both external factors (e.g. difficulty in locomotion and transport), (Brandão, Oliveira, Brandão, & et al., 2018) and fear. For example, Siegrist and colleagues state that concerns related to the fear of falling are found in 43% of the sample and 16% confirm that they reduce their usual activity to avoid risks: in the study, the subjects belonging to the intervention group, based on the prevention through physical exercise of 12 months, significantly reduced the fear of falling, compared to the group that received only the usual care provided by the National Health System. (Siegrist, et al., 2016) A further study adds that, following a fall prevention exercise program, the self-confidence of subjects who practiced in the exercise group improved significantly. (Iliffe, Kendrick, Morris, Griffin, & Haworth, 2015) These statements make us reflect on the importance of acting in a preventive manner, but above all through individualized and stimulating proposals, that is, which take into account personal needs and obtain a high degree of adherence, even in the long term. An article examined the percentage of completion of the programs once the study period ended, finding that: 84.7% of the participants in the intervention group committed themselves to continuing the lessons for the following 6 months, decreasing to 79, 1% at 12 months, obtaining statistically greater results than the control group. (Martins, et al., 2018) In this regard, with a view to long-term adherence, it should be considered to offer programs that consider both personal needs and the features of the program itself.

The evidence supports the thesis that the elderly chooses a certain physical activity, not only taking into account the benefits that it entails, but above all on the basis of particular characteristics, i.e., the distance from their home and the costs to be incurred, followed subsequently by the possibility of increase the ability to carry out daily life actions and reduce falls to a minimum. These statements highlight those strategies developed to engage seniors need to focus not only on health but on improving accessibility to exercise

programs. (Franco, et al., 2015) Exercise that can be done at home or in the nearby, at no additional cost, is what most drives the elderly to undertake a physical activity program and follow it constantly over time. Various studies deal with physical exercise carried out in gyms or specialized centres, precisely because most of the programs are conducted in this type of facility, offering purely group activities. The most important consequence is found in the fact that the proposed protocols are less accessible to the elderly who, often, are not willing to go regularly to these centres. Therefore, the review of the studies allows us to affirm that home business is an excellent “*medicine*” that uses Home-Fitness as its main ingredient, and that often, good results can also be obtained by following a program of exercise at home proposed via video or DVD, at low cost. (McAuley, Wójcicki, & Gothe, 2013) (Fanning, et al., 2016)

Therefore, making physical activity easy and rewarding allows you to increase the number of subjects who practice it, placing a limit on the development of frailty. The latter, in fact, is a “*multifactorial geriatric syndrome, characterized by low physiological reserves and reduced resistance to stress events*”, and many studies states that it is directly proportional to age. A clinical condition that has attracted particular attention in recent decades, also thanks to the dizzying growth of the elderly population and the prospect of life. (Pilotto, Custodero, & Maggi, 2020) Physical activity has been identified as a potential preventive strategy for both frailty in people aged 65 years and older. (Oliveira, et al., 2020) One study state that in frail or pre-frail subjects, an exercise program associated with an eating plan decreased the frailty score by 0.34 from baseline, the exercise program alone by 0.23, after 6 months. (Hsieh, Su, Chen, Kang, & Hu, 2019) Although minimal, these results are statistically significant in a population so sensitive to changes and improvements in physical and mental condition. The evidence reinforces the idea that the activity within the domestic walls is a highly recommended tool to prevent the onset of frailty and in some cases to reduce it, although it is not always possible to improve this condition at an advanced stage. We cite two studies that provide evidence that a prevention program, in frail elderly living at home, can delay functional decline, underlining however non-negligible aspects: “*despite the intervention, people with recognized severe frailty have had a worsening of disability over time*” (Gill, et al., 2002) and “*although exercise improves functional capacity, frailty has not been eliminated with training*”. (Brown, Sinacore, Ehsani, & al, 2000) The findings indicate the need to prevent this condition, rather than wasting energy in modifying it at an advanced stage. In this context, it is considered essential to recognize the elderly predisposed to develop a condition of fragility and to intervene effectively, preventing possible risks and the loss of independence. As various scholars state in “*The American Journal of Medicine*”, it is possible, thanks to prevention (Ng, et al., 2015), to identify people at risk and avoid hospitalization, institutionalization, functional dependence, or death. According to the literature, older people living in communities, in their home, always report better results than those living in institutions. (Haider, Grabovac, & Dorner, 2019).

Although frailty is a topic to focus attention on, in relation to the elderly we reiterate that the prevention of falls is equally important and is a source of study for many researchers who work in the protection of the health of the elderly and trust in movement as a means to get it. All the evidence collected allows us to state that a home exercise program based on improving the balance and strengthening of the lower limbs, proves to be an effective element in reducing the number of falls. A study reveals that following the strength and balance protocol, the difference in the rate of falls, between the exercise group and the usual care group, increased over time in favour of the exercise group, although it is unclear whether they are also valid on subjects with different criteria from those provided for in the inclusion. (Liu-Ambrose, Davis, & Best, 2019) Again, the various reviewed studies that dealt with this issue confirm that the average fall rate during the program period was significantly lower in the exercise groups than to control groups, leading to an improvement in the balance itself. A non-negligible positive consequence is the reduction in the number of fractures related to the fall. Finally, an article attempted to show that a fall prevention exercise program was correlated with bone

mineral density, not achieving the desired results, explained by the fact that, perhaps, the exercises should have applied greater loads to the bone or exercise efforts of greater duration, confirming that the action of physical exercise in situations of osteopenia and osteoporosis is positive, if applied appropriately and not below the activation threshold. (Duckham, et al., 2015)

In addition to the concrete benefits shown, physical exercise carried out at home is confirmed as an excellent practice useful for optimizing the level of physical performance and consequently ensures a good residual autonomy. The evidence of greatest interest, relating to physical performance, can be found in the test scores present in each study. Obviously, the results cannot be compared, since they are data deriving from different use of measurement methods, proposed programs, clinical states and inclusion criteria. We can without considering the specific scores of each study, summarize the objective certainties obtained from the review, stating that physical exercise carried out at home in the elderly involves an increase of: muscle strength (in particular of the lower limbs), SPPB score that evaluates the functionality of the lower limbs, average walking speed and resistance, TUG score that evaluates mobility, static and dynamic balance, PPA score associated with decreased risk of falls, Barthel index score for functionality (ADL), flexibility, coordination, grip strength or less reduction compared to the control group.

CONCLUSION

The purpose of this work is to provide an overview of the critical issues and benefits related to exercise at home in the elderly, to understand the importance it has in this population. We can declare that there are many studies that examine this issue, but the main difficulty is certainly found in intertwining the results obtained.

Although it was not easy to evaluate the studies, due to the multiplicity of objectives, measurement and inclusion criteria, the evidence determines in depth the relationship between physical activity at home and over 65. Many studies conclude that, the elderly healthy people who regularly engage in moderate-intensity physical activity have a higher level of quality of life and well-being, both in the physical and mental domain, than less physically active subjects and give hope for an extended active life in old age. (Arkkukangas, Sundler, Söderlund, Eriksson, & Johansson, 2017)

Further data is needed to find the precise correlation between the results that can be obtained and the most effective mode of exercise in influencing a certain aspect, but we can assert that a multicomponent program that allows you to act in favour of the whole organism, is the solution to date, completer and more effective. What is reported by the scientific evidence and stated by the American College of Sports Medicine (ACSM): many reviews *“have demonstrated the superior effectiveness of multi-component exercise programs compared to mono-component exercise programs”*, which include more than one type of exercise. (Freiberger, Kemmler, Siegrist, & Sieber, 2016)

To date, it is essential to improve accessibility to programs and increase long-term adherence. With a view to participation, two proposals are interesting: one allowed participants to take part in their treatment process, choosing together with the supervisor the exercises they wanted to perform, creating a change in the culture of assistance, (Mittaz Hager, et al., 2019) while the other providing for supervision by lay staff, or previously trained volunteers who followed the elderly unable to move from their homes, reducing both health costs and finding an alternative to the problem of lack of supervision. (Kapan, Winzer, & Haider, 2017) In this regard, we remind you that supervised training leads to greater benefits, in terms of performance and motivation, than unsupervised training.. (Lacroix, et al., 2016)

We conclude the review by being able to certify, following all the data collected, that physical activity carried out at home by elderly people is an excellent tool to hinder the onset of problems related to advancing age, bringing all the benefits returned previously. We summarize the results by reiterating that: it prevents and decreases the number of falls; avoids the loss of residual autonomy and the onset of a condition of fragility; improves physical performance, such as balance, strength, mobility, flexibility, aerobic capacity, etc.; it brings benefits on a cognitive level; finally, it allows you to increase your mood and general well-being. In addition, physical intervention, related to correct lifestyles, is able to reduce the self-reported rate of functional decline, compared to the results found in sedentary subjects.

Taking into account that the number of elderly people is constantly growing and that, even today, a large majority of them are sedentary or do not reach the amount of physical activity required by the world's major health organizations, not enjoying the related benefits, the Home-Fitness proves to be a complete, effective and accessible to everyone, even more so for the elderly.

AUTHOR CONTRIBUTIONS

Alessandro Capriotti: Quality control, article search, development of the final product. Valeria Patregnani: Articles search, manuscript preparation. Ario Federici: Project coordinator.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

REFERENCES

- Arkkukangas, M., Sundler, A., Söderlund, A., Eriksson, S., & Johansson, A. (2017, Dec). Older persons' experiences of a home-based exercise program with behavioral change support. *Physiother Theory Pract.* <https://doi.org/10.1080/09593985.2017.1359869>
- Baert, V., Gorus, E., Mets, T., & Bautmans, I. (2015, Jul-Sep). Motivators and barriers for physical activity in older adults with osteoporosis,. *Journal of Geriatric Physical Therapy.* <https://doi.org/10.1519/jpt.0000000000000035>
- Barry, A., Heale, R., Pilon, R., & Lavoie, A. (2018, Jul 4). The meaning of home for ageing women living alone: An evolutionary concept analysis,. *Health and Social Care in Community.* <https://doi.org/10.1111/hsc.12470>
- Bjerk, M., Brovold, T., Skelton, D., & Bergland, A. (2017, Aug 14). A falls prevention programme to improve quality of life, physical function and falls efficacy in older people receiving home help services: study protocol for a randomised controlled trial,. *BMC Health Serv Res.* <https://doi.org/10.1186/s12913-017-2516-5>
- Brandão, G., Oliveira, L., Brandão, G., & et al. (2018, Dec 12). Effect of a home-based exercise program on functional mobility and quality of life in elderly people: protocol of a single-blind, randomized controlled trial,. *Trials.* <https://doi.org/10.1186/s13063-018-3061-1>
- Brown, M., Sinacore, D., Ehsani, A. B., & al, e. (2000, Jul). Low-intensity exercise as a modifier of physical frailty in older adults,. *Arch Phys Med Rehabil.* <https://doi.org/10.1053/apmr.2000.4425>

- Campbell, A., Robertson, M., Gardner, M., Norton, R., Tilyard, M., & Buchner, D. (1997, Oct 25). Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. *BMJ*. <https://doi.org/10.1136/bmj.315.7115.1065>
- Chen, H., Zheng, X., Huang, H., Liu, C., Wan, Q., & Shang, S. (2019, Apr 9). The effects of a home-based exercise intervention on elderly patients with knee osteoarthritis: a quasi-experimental study. *BMC Musculoskelet Disord*. <https://doi.org/10.1186/s12891-019-2521-4>
- Clegg, A., Barber, S., Young, J., Iliffe, S., & Forster, A. (2014, Sep). The Home-based Older People's Exercise (HOPE) trial: a pilot randomised controlled trial of a home-based exercise intervention for older people with frailty. *Age Ageing*. <https://doi.org/10.1093/ageing/afu033>
- Clegg, A., Young, J., Iliffe, S., Rikkert, M., & Rockwood, K. (2013, Mar 2). Frailty in elderly people. *Lancet*. [https://doi.org/10.1016/s0140-6736\(12\)62167-9](https://doi.org/10.1016/s0140-6736(12)62167-9)
- Costello, E., Kafchinski, M., Vrazel, J., & Sullivan, P. (2011, Jul-Sep). Motivators, barriers, and beliefs regarding physical activity in an older adult population. *Journal of Geriatric Physical Therapy*. <https://doi.org/10.1519/jpt.0b013e31820e0e71>
- Courtin, E., & Knapp, M. (2015, May). Social isolation, loneliness and health in old age: a scoping review. *Health and Social Care in the Community*. <https://doi.org/10.1111/hsc.12311>
- Duckham, R., Masud, T., Taylor, R., Kendrick, D., Carpenter, H., Iliffe, S., . . . Skelton, D. (2015, Jul). Randomised controlled trial of the effectiveness of community group and home-based falls prevention exercise programmes on bone health in older people: the ProAct65+ bone study. *Age Ageing*. <https://doi.org/10.1093/ageing/afv055>
- European Commission. (2021). The 2021 Ageing Report. Underlying Assumptions & Projection Methodologies Institutional Paper 142, Bruxelles.
- Fairhall, N., Sherrington, C., Lord, S., Kurrle, S., Langron, C., Lockwood, K., . . . Cameron, I. (2014, Sep). Effect of a multifactorial, interdisciplinary intervention on risk factors for falls and fall rate in frail older people: a randomised controlled trial. *Age Ageing*. <https://doi.org/10.1093/ageing/afv204>
- Fanning, J., Awick, E., Wójcicki, T., Gothe, N., Roberts, S., Ehlers, D., . . . McAuley, E. (2016, Jun). Effects of a DVD-Delivered Exercise Intervention on Maintenance of Physical Activity in Older Adults. *J Phys Act Health*. <https://doi.org/10.1123/jpah.2015-0173>
- Federici, A., & Dardanella, R. (2006). *Home-Fitness Ginnastica a domicilio per la terza età, Quaderni di Attività Motoria*. Urbino: Ed. Montefeltro.
- Federici, A., & Palanca, R. (2019, Oct 22). Home-fitness: physical exercise and elderly's quality of life. *Journal of Physical Education and Sport*.
- Federici, A., Conteduca, R., Lucertini, F., Dell'Anna, S., Ferri Marini, C., & Vetri, M. (2018, Jun 30). Effect of a psychomotor training program on hand function in nursing home residents: a pilot study. *Journal of Physical Education and Sport*.
- Federici, A., Valentini, M., & Tonini Cardinali, C. (2000). *Sportivamente anziano - Proposte motorie per la terza età*. Urbino: Ed. Montefeltro.
- Franco, M., Howard, K., Sherrington, C., Ferreira, P., Rose, J., Gomes, J., & Ferreira, M. (2015, Jan). Eliciting older people's preferences for exercise programs: a best-worst scaling choice experiment. *Physiother*. <https://doi.org/10.1016/j.jphys.2014.11.001>
- Franco, M., Tong, A., Howard, K., Sherrington, C., Ferreira, P., Pinto, R., & Ferreira, M. (2015, Oct). Older people's perspectives on participation in physical activity: a systematic review and thematic synthesis of qualitative literature. *British Journal of Sport Medicine*. <https://doi.org/10.1136/bjsports-2014-094015>
- Freiberger, E., Kemmler, W., Siegrist, M., & Sieber, C. (2016, Oct). Frailty and exercise interventions : Evidence and barriers for exercise programs. *Z Gerontol Geriatr*. <https://doi.org/10.1007/s00391-016-1134-x>

- Gawler, S., Skelton, D., Dinan-Young, S., Masud, T., Morris, R., Griffin, M., . . . Iliffe, S. (2016, Nov-Dec). Reducing falls among older people in general practice: The ProAct65+ exercise intervention trial. *Arch Gerontol Geriatr.* <https://doi.org/10.1016/j.archger.2016.06.019>
- Gill, T., Baker, D., Gottschalk, M., Peduzzi, P., Allore, H., & Byers, A. (2002, Oct 3). A program to prevent functional decline in physically frail, elderly persons who live at home. *N Engl J Med.* <https://doi.org/10.1056/nejmoa020423>
- Haider, S., Dorner, T., & Luger, E. (2017, Jan 13). Impact of a Home-Based Physical and Nutritional Intervention Program Conducted by Lay-Volunteers on Handgrip Strength in Prefrail and Frail Older Adults: A Randomized Control Trial. *PloS One.* <https://doi.org/10.1371/journal.pone.0169613>
- Haider, S., Grabovac, I. M., & Dorner, E. (2019, Jun). Effects of physical activity interventions in frail and prefrail community-dwelling people on frailty status, muscle strength, physical performance and muscle mass-a narrative review. *Wien Klin Wochenschr.* <https://doi.org/10.1007/s00508-019-1484-7>
- Harridge, D., & Lazarus, N. (2017, Mar). Physical Activity, Aging, and Physiological Function. *Physiology* (Bethesda).
- Hsieh, T., Su, S., Chen, C., Kang, Y., & Hu, M. (2019, Dec 2). Hsieh T.J., Su S.C., Chen C.W. et al., Individualized home-based exercise and nutrition interventions improve frailty in older adults: a randomized controlled trial., *Int J Behav Nutr Phys Act.* <https://doi.org/10.1186/s12966-019-0855-9>
- Hwang, H., Chen, S., J., L.-H., Chien, D., Chen, C., & M.R., L. (2016, Feb). Effects of Home-Based Tai Chi and Lower Extremity Training and Self-Practice on Falls and Functional Outcomes in Older Fallers from the Emergency Department- A Randomized Controlled Trial. *Journal fo the American Geriatrics Society.* <https://doi.org/10.1111/jgs.13952>
- Iliffe, S., Kendrick, D., Morris, R., Griffin, M., & Haworth, D. (2015, Nov). Proact65+ research team., Promoting physical activity in older people in general practice: ProAct65+ cluster randomised controlled trial., *Br J Gen Pract.* <https://doi.org/10.3399/bjgp15x687361>
- Jette, A., Lachman, M., Giorgetti, M., Assmann, S., Harris, B., Levenson, C., . . . Krebs, D. (1999, Jan). Exercise--it's never too late: the strong-for-life program. *Am J Public Health.* <https://doi.org/10.2105/ajph.89.1.66>
- Kapan, A., Winzer, E., & Haider, S. (2017, Jul 19). Impact of a lay-led home-based intervention programme on quality of life in community-dwelling pre-frail and frail older adults: a randomized controlled trial., *BMC Geriatr.* <https://doi.org/10.1186/s12877-017-0548-7>
- Korpelainen, R., Keinänen-Kiukaanniemi, S., Nieminen, P., Heikkinen, J., Väänänen, K., & Korpelainen, J. (2009, Dec). Effect of Exercise on Extraskelatal Risk Factors for Hip Fractures in Elderly Women with Low BMD: A Population-Based Randomized Controlled Trial. *JBMR.* <https://doi.org/10.1359/jbmr.060116>
- Korpelainen, R., Keinänen-Kiukaanniemi, S., Nieminen, P., Heikkinen, J., Väänänen, K., & Korpelainen, J. (2010, Sep). Long-term Outcomes of Exercise: Follow-up of a Randomized Trial in Older Women with Osteopenia. *Arch Intern Med.* <https://doi.org/10.1001/archinternmed.2010.311>
- Lacroix, A., Kressig, R., Muehlbauer, T., Gschwind, Y., Pfenninger, B., & Bruegger, O. (2016). Effects of a Supervised versus an Unsupervised Combined Balance and Strength Training Program on Balance and Muscle Power in Healthy Older Adults: A Randomized Controlled Trial. *Gerontology.* <https://doi.org/10.1159/000442087>
- Lee, P., Jackson, E., & Richardson, C. (2017, Apr 1). Exercise Prescriptions in Older Adults. *American Family Physician.*
- Liu-Ambrose, T., Davis, J., & Best, J. (2019, Jun 4). Effect of a Home-Based Exercise Program on Subsequent Falls Among Community-Dwelling High-Risk Older Adults After a Fall: A Randomized Clinical Trial. *JAMA.* <https://doi.org/10.1001/jama.2019.5795>

- Martins, A., Santos, C., Silva, C., Baltazar, D., Moreira, J., & Tavares, N. (2018, Jul 10). Does modified Otago Exercise Program improves balance in older people? A systematic review,. *Prev Med Rep.* <https://doi.org/10.1016/j.pmedr.2018.06.015>
- McAuley, E., Wójcicki, T., & Gothe, N. (2013, Sep). Effects of a DVD-delivered exercise intervention on physical function in older adults,. *J Gerontol A Biol Sci Med Sci.*
- McLeod, M., Breen, L., Hamilton, D., & Philp, A. (2016, Jun). Live strong and prosper: the importance of skeletal muscle strength for healthy ageing,. *Biogerontology.* <https://doi.org/10.1007/s10522-015-9631-7>
- Meng, N., Li, C., Liu, C., Lin, C., Chang, C., Chang, H., . . . Lin, C. (2020, Jul 17). Effects of concurrent aerobic and resistance exercise in frail and pre-frail older adults: A randomized trial of supervised versus home-based programs. *Medicine (Baltimore).* <https://doi.org/10.1097/md.00000000000021187>
- Middleton, A., Simpson, K., Bettger, J., & Bowden, M. (2020., May 5). Pandemic and Beyond: Considerations and Costs of Telehealth Exercise Programs for Older Adults With Functional Impairments Living at Home-Lessons Learned From a Pilot Case Study. *Journal of the American Physical Therapy Association.* <https://doi.org/10.1093/ptj/pzaa089>
- Mitnitski, A., Graham, J., Mogilner, A., & Rockwood, K. (2002, Feb 27). Frailty, fitness and late-life mortality in relation to chronological and biological age. *BMC Geriatrics.* <https://doi.org/10.1186/1471-2318-2-1>
- Mittaz Hager, A., Mathieu, N., Lenoble-Hoskovec, C., Swanenburg, J., De Bie, R., & Hilfiker, R. (2019, Jan 14). Effects of three home-based exercise programmes regarding falls, quality of life and exercise-adherence in older adults at risk of falling: protocol for a randomized controlled trial,. *BMC Geriatr.* <https://doi.org/10.1186/s12877-018-1021-y>
- Montero-Fernández, N., & Serra-Rexach, J. (2013, Feb). Role of exercise on sarcopenia in the elderly. *European Journal of Physical and Rehabilitation Medicine.*
- Morey, M., Snyder, D., Sloane, R., Cohen, H., Peterson, B., Hartman, T., . . . Demark-Wahnefried, W. (2009, May 13). Effects of home-based diet and exercise on functional outcomes among older, overweight long-term cancer survivors: RENEW: a randomized controlled trial. *JAMA.* <https://doi.org/10.1001/jama.2009.643>
- Nelson, E., Layne, J., Bernstein, M., Nuernberger, A., Castaneda, C., Kaliton, D., . . . Fiatarone Singh, M. (2004, Feb). The Effects of Multidimensional Home-Based Exercise on Functional Performance in Elderly People. *The Journals of Gerontology.* <https://doi.org/10.1093/gerona/59.2.m154>
- Ng, T., Feng, L., Nyunt, M., Feng, L., Niti, M., & Tan, B. (2015, Nov). Nutritional, Physical, Cognitive, and Combination Interventions and Frailty Reversal Among Older Adults: A Randomized Controlled Trial. *The American Journal of Medicine.* <https://doi.org/10.1016/j.amjmed.2015.06.017>
- Nilsson, M., Mikhail, A., Lan, L., Di Carlo, A., Hamilton, B., Barnard, K., . . . Tarnopolsky, M. (2020, Aug 10). A Five-Ingredient Nutritional Supplement and Home-Based Resistance Exercise Improve Lean Mass and Strength in Free-Living Elderly. *Nutrients.* <https://doi.org/10.3390/nu12082391>
- Oliveira, J., Pinheiro, M., Fairhall, N., Walsh, S., Chesterfield, F., Kwok, W., . . . Sherrington, C. (2020, Aug 11). Evidence on Physical Activity and the Prevention of Frailty and Sarcopenia Among Older People: A Systematic Review to Inform the World Health Organization Physical Activity Guidelines. *J Phys Act Health.* <https://doi.org/10.1123/jpah.2020-0323>
- Pilotto, A., Custodero, C., & Maggi, S. (2020, Jul). A multidimensional approach to frailty in older people. *Ageing Research Reviews.* <https://doi.org/10.1016/j.arr.2020.101047>
- Rantanen, T., & Saajanaho, M. (2018, May 2). Active aging – resilience and external support as modifiers of the disablement outcome: AGNES cohort study protocol,. *BMC Public Health.* <https://doi.org/10.1186/s12889-018-5487-5>

- Schutzer, K., & Graves, B. (2004, Nov). Barriers and motivations to exercise in older adults,. Preventive Medicine. <https://doi.org/10.1016/j.ypmed.2004.04.003>
- Siegrist, M., Freiberger, E., Geilhof, B., Salb, J., Hentschke, C., Landendoerfer, P., . . . Blank, W. (2016, May 27). Fall Prevention in a Primary Care Setting,. Dtsch Arztebl Int. <https://doi.org/10.3238/arztebl.2016.0365>
- Thomas, S., Mackintosh, S., & Halbert, J. (2010, Nov). Does the 'Otago exercise programme' reduce mortality and falls in older adults?: a systematic review and meta-analysis,. Age Ageing. <https://doi.org/10.1093/ageing/afq102>
- United Nations. (2019). World Population Ageing 2019. In P. D. Department of Economic and Social Affairs (Ed.), Highlights (ST/ESA/SER.A/430). <https://doi.org/10.18356/f9a66f86-en>
- Walters, K., Frost, R., Kharicha, K., Avgerinou, C., Gardner, B., Ricciardi, F., . . . Iliffe, S. (2017, Dec). Home-based health promotion for older people with mild frailty: the HomeHealth intervention development and feasibility RCT. Health Technol Assess. <https://doi.org/10.3310/hta21730>
- World Health Organization. (2020). World health statistics 2020. monitoring health for the SDGs, sustainable development goals, Geneva.



This work is licensed under a [Attribution-NonCommercial-ShareAlike 4.0 International](https://creativecommons.org/licenses/by-nc-sa/4.0/) (CC BY-NC-SA 4.0).