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Review Article

Recommendations for physical activity in the elderly population: A scoping review of guidelines

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Abstract

Physical inactivity and sedentary time are associated with all-cause mortality, chronic non-communicable diseases and falls in the elderly. Objective of this review is to assess and summarize recommendations from clinical guidelines for physical activity (PA) of older adults in general and related to falls. A scoping review of the existing clinical guidelines was conducted. The included studies should have been developed under the auspices of a health organization and their methodology should be described in detail. Nine clinical guidelines providing specific recommendations for the elderly were identified. There was a strong agreement across the guidelines regarding goals, activities parameters, adverse effects of PA, in addition to reference for preventing falls. Keeping even the minimum of physical activity, introducing balance exercises and strengthening exercises for preventing falls, avoiding unexpected accelerations in the intensity of the activities, applying the necessary precautions and consulting a health professional are the main pillars of recommendations. Despite any deficiencies in definitions, monitoring and optimal dosage consistency of recommendations, is an ideal incentive for countries and organizations to adopt and enhance physical activity as an antidote to the degeneration of human's health and quality of life.

Keywords: Clinical guidelines, Older adults, Physical activity

Introduction

Physical inactivity has become a negative hallmark of modern lifestyle that strongly correlates with extrinsic factors such as climate change and urbanization and intrinsic factors such as unhealthy behaviors and can be met in all ages, but particularly in older adults[1,2]. Physical inactivity, defined as no activity except baseline daily activities, is reported in 26.9% of adults 65-74 years old and mostly by women[3]). In the same North American survey[3] one out of three older adults with a medical record of at least one chronic disease were classified as inactive. Levels of inactivity are correlated with age and body mass index and are less in persons with higher levels of education. A similar prevalence of physical inactivity is reported in Europe. More than 40% of the adult European population does not engage in any form of physical activity, and only 8% regularly exercise[4]. Overall prevalence of physical inactivity in older adults across Europe is associated with increasing age, and the presence of depression and cognitive impairment[5].

Sedentary behavior and physical inactivity are directly linked with increased prevalence of cardiovascular disease[6], obesity, diabetes[7] and autoimmune rheumatic diseases[8]. Physical inactivity has a huge socioeconomic cost, with an estimated contribution of 3.7% of health care costs in Canada, and is associated with increased morbidity and

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consequent use of health care services[9]. It is the fourth leading risk factor for global mortality[1]. The adaptation of a sedentary behavior increase the injury-related risk of falling in the older adults[10].

Increasing levels of physical activity (PA) acts as a catalyst in the reduction of the above consequences. Recommended levels of PA decrease the risk of hip fractures in older adults[11], the risk of the development for more than twenty chronic Non Communicable Diseases (NCD) including diabetes[12,13], cardiovascular and chronic respiratory diseases[2] and cancer risk by 7%[14]. Additionally, PA reduce cognitive decline[15]) and all-cause mortality risk[16]. Increasing PA even during the 7th decade of life is considered as important as smoking cessation for reducing mortality in older adults[17].

There are several systematic reviews of the existing studies addressing the effect of PA in healthy ageing[18-20] in addition to a meta-analysis of the systematic reviews with respect to the health benefits of PA[21]. Hence, vast majority of the studies focuses on the causative relationship between physical inactivity and occurrence of medical entities. However, there is no detailed evidence about the exact type and intensity of PA. The evidence for the benefits of PA for healthy ageing is compelling, and this is reflected in the existence of several guidelines for different health conditions that provide recommendations for PA. The objective of this paper is to conduct a scoping literature review of the existing clinical guidelines and summarize the evidence and recommendations which refer to PA for older adults. A secondary aim is to summarize recommendations about PA as a supportive intervention for balance disorders and postural impairment.

Methodology

This is a scoping review aiming to identify guidelines for PA and extract the recommendations targeting the elderly population. The literature search included records from Pubmed, the National Institute for Health and Care Excellence, the National Guideline Clearinghouse and Google scholar (the first 20 pages of search results). The literature search was conducted from 26 June 2020 to 18 July 2020. Terms for search in the databases were "physical activity", "older adults" and "guideline".

Two reviewers (CN and DK) independently screened search results by title, abstract or full text and extract data. For any disagreement between authors a third expert was planned to be consulted, however this was not deemed necessary. Data extraction was based on a structured form created for the needs of this review. Criteria for including studies into this review were:

a) to be claimed as clinical guidelines. Documents under the titles fact sheets and reviews were excluded.
b) to be authored by a specific scientific group under the responsibility of a health organization. In the case of the existence of more than one such paper from the organization, the most recent version was included in this review.
c) to have a clearly described methodology including a definition of the target population, data selection and evaluation, specific and clear aims of the guideline and rules for decision making.
d) to include age-specific recommendations and target older adults over 65 years old.
e) to include quantifiable and clear recommendations of PA promotion either exclusively or explicitly including the elderly population over 65.

No restrictions concerning date of publication were imposed.

Exclusion criteria were:

a) Narrative reviews or systematic reviews limited to summary of published evidence hence without any clearly stated recommendations and/or that were not conducted for the purpose of providing guidelines
b) Guidelines that were not commissioned or adopted by a health and/or professional or governing organization
c) Guidelines that referred only to institutionalized – hospitalized populations
d) Guidelines that did not clearly include older adults as a specific population group
e) Guidelines written in a language other than English

Recommendations for the elderly population were extracted from each guideline and were summarized in terms of duration, intensity and frequency. Moreover, definition of PA as well as examples of actual physical activity were included. Special consideration was given to any recommendation or comment related to balance disorders, postural impairment and balance-oriented physiotherapy, however, guidelines not containing either a dedicated specific part or some kind of referral related to balance and posture were not excluded from our review.

Information extracted from the guidelines passed the screening was the following:

- country
- year of publication
- funding body
- source of evidence used
- description of methodology (how consensus was reached, methods used for literature review)
- criteria for data selection
- level of evidence of the included literature
- link between evidence and recommendation
- target group of recommendations (definition of elderly population)
- conflict of interest

Furthermore, evidence with respect to duration, frequency, intensity of PA, comments on sedentary time and goals achieved by PA promotion were retrieved. Data extracted were integrated in tables and differences or similarities on recommendations about PA's intensity, frequency and duration were listed.

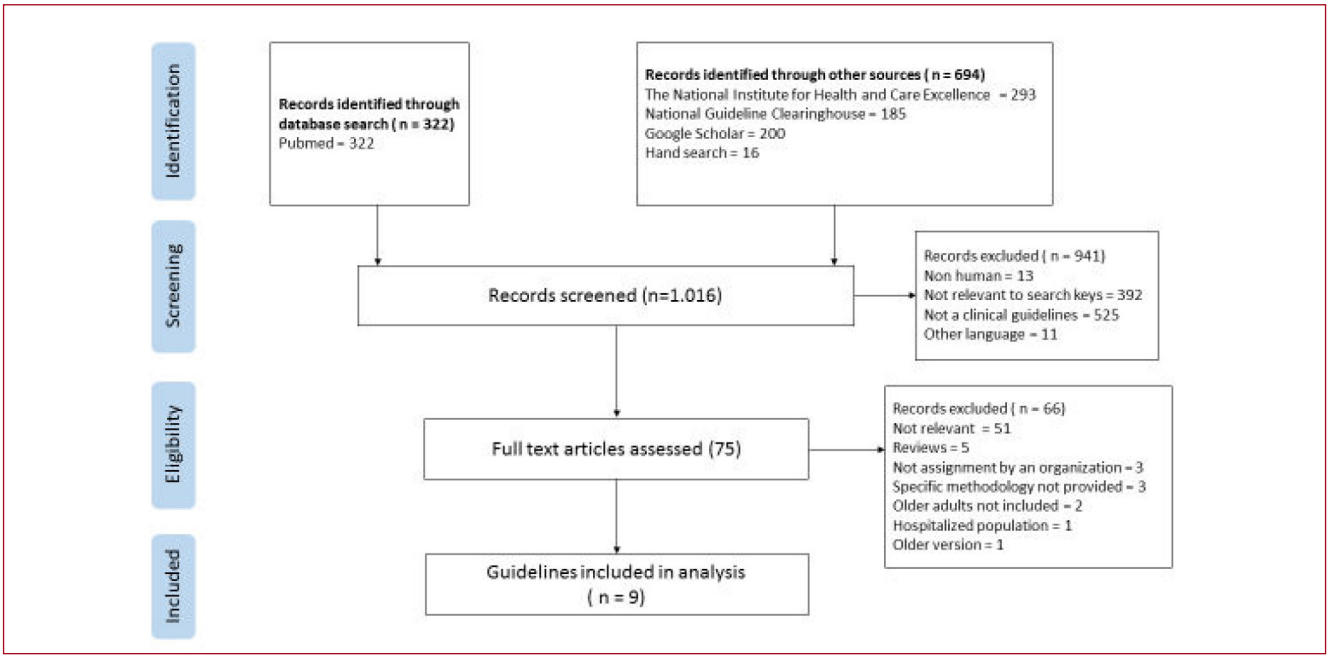

Figure 1. Flowchart of study screening, eligibility and inclusion.

Results

Nine clinical guidelines were included in the study: **WHO**[2] (World Health Organization, 2010), **USA**[22] (Department of Health and Human Services, 2018), **Canada**[23] (Canadian Society for Exercise Physiology, 2011), **Germany**[24] (Rütten, 2016), **United Kingdom – UK**[25] (Department of Health, Physical Activity, Health Improvement and Protection, 2011), **Australia**[26] (Brown, 2006), **the Netherlands**[27] (Weggemans, 2018), **New Zealand**[28] (Ministry of Health, 2013) and **India**[29] (Misra, 2012). The flowchart of the selection process is presented in Figure 1. Three guidelines were excluded at the eligibility phase as specific methodology was not provided[30-32]. Most of the guidelines were published after 2010 with an exception of the Australian guidelines which were presented in 2006.

Methodology

All the included guidelines provide details on the development process as required by the inclusion criteria. Six out of nine guidelines used established or customized instruments for grading the source evidence[2,23,24,26,28]. Six out of nine guidelines[2,23,24,28,29] declared that took under consideration previous published guidelines either adapting recommendations or harmonized their documents. Original systematic reviews of the current evidence at the time of development were produced by the majority[2,22,23,26,28,29]. Face to face meetings or workshops followed by comprehensive feedback was the most popular method for reaching consensus, adopted by six out of nine health and/or professional or governing organizations[2,22,23,25,29]. A multidisciplinary group of experts were recruited for the development for almost all documents (only Australia's guidelines[26] was an effort of a small group of experts). Only two papers have a special report to population subgroups[26,27]. Detailed information about the development of the included clinical guidelines, the professionals involved as well as stakeholders and funding procedure are listed in Table 1 and Table 2.

Definition of PA

All manuscripts agree that PA is "any body movement produced by skeletal muscles that requires substantial energy expenditure above and beyond resting energy expenditure and produces progressive health benefits". The Netherlands[27] guidelines expanded the definition by specifying that PA has an endurance and strength component. In Canada's recommendation[23], is urged to investigate and extend the definition specifically for the elderly related to specific outcomes. In German's[24] guidelines definition of PA includes all "health-enhancing physical activity, meaning any form of physical activity that benefits health and functional capacity without undue harm and risk (leisure and leisure activities, e.g. cycling and walking, and sports activities as well as physical work at home or at workplace".

Intensity of PA

The definition of moderate-intensity and vigorous-intensity physical activity was provided by all clinical

Table 1. Summary of the development of the clinical guidelines.

Country	Evidence criteria	Source of evidence	Method reaching consensus	Peer review?
WHO,2010	Guidelines were based on already existing evidence and literature reviews created for this scope. After collecting and analyzing evidence, narrative description of the evidence was developed, assessed by the guideline's group members. The whole process was divided in six phases from scope definition to implementation.	• A Centers for Disease Control and Prevention (CDC) conducted a literature review • An existing systematic review about benefits of PA • Updated Canadian guidelines • Chinese and Russian literature review based on the same search framework as CDC's review.	The first draft of guidelines was assessed electronically by guideline's group members using a standard reporting form. A face to face meeting followed for reviewing, discussing and finalizing the recommendations.	Guidelines were peer-reviewed by the WHO regional offices and relevant departments.
USA,2018	Guidelines were based mostly on the 2018 Physical Activity Guidelines Advisory Committee Scientific Report. The Committee confirmed or updated revisions based on the Physical Activity Guidelines Advisory Committee Grading Criteria.	The Committee provided the Scientific Report as a result of systematic reviews on the existing literature, discussed during at least five dedicated meetings in which stakeholders were present and extended minutes were recorded.	Face-to face consensus in public sessions. Comments from public and agencies (federal staff and policy officials), submitted in a web-based platform were taken under consideration.	Yes (peer-reviewed across the federal government prior publication).
Canada,2011	The Physical Activity Measurement and Guidelines steering committee commissioned several narrative and systematic reviews towards collection and evaluation of current evidence as well as developing and evaluating guidelines. As a result three systematic reviews examining the relationship between PA and age matched population were held. The Appraisal of Guidelines for Research Evaluation (AGREE) II tool was used for assessing evidence. Several meetings took place prior to final launch.	Based mainly on the evidence from three systematic reviews. Additional reviews explained development's methodology and dissemination needed actions.	Multiple face-to face consensus meetings followed by comprehensive feedback, provided either in-person or online, from a wide range of stakeholders (experts, health professionals, government and non-governmental organizations).	No
Germany,2016	A three phase process was implemented, including: • extraction of systematic reviews used in previous recommendations using quality criteria, • critical review of existing recommendations for PA, • content analysis and synthesis of current recommendations.	Five guidelines were identified as source recommendation for each age group included. Systematic reviews on which these recommendations were based, were critically reviewed.	Not stated.	Not stated.
UK, 2011	Revision of current recommendations based on key documents recognized as primary sources. The result was review papers upon a set of key questions. The Physical Activity Guidelines Editorial Group was responsible for writing final guidelines.	Four primary evidence sources were identified: • US Physical Activity Guidelines Advisory Committee Report of 2008 • Canadian Physical Activity Guidelines reviews • British Association of Sport and Exercise Sciences reviews • High quality reviews not covered in the previous sources.	Face-to face consensus meeting followed by national web-based (teleconferences) consultation's feedback.	Not stated.
Australia, 2006	A review of the contemporary literature was held in four stages from framework development to reviewing the existing evidence and guidelines (eligible evidence was rated according to National Health and Medical Research Council criteria and scored accordingly and guidelines were assessed by the Appraisal of Guidelines Research and Evaluation instrument) to formulating and refining recommendations.	Literature review focus on randomized controlled trials and systematic reviews producing a draft of recommendations which was refined by an external expert advisory group.	Consensus using a Delphi survey process after two workshops.	Recommendations reviewed by the advisory group and stakeholders, feedback received also from older people via focus groups.
Netherlands, 2017	The Physical Activity Guidelines committee produced two background documents: one for physical activity and one for sedentary behavior and risk of chronic diseases. The assessment of the relevant eligible studies was based on a decision tree described on a background document. The conclusions converted into guidelines.	Pooled analysis, meta-analysis and systematic review of cohort studies (with respect to associations between physical activity and sedentary behavior and chronic diseases) and randomized controlled trials (with respect to causality).	Two systematic reviews were conducted but no information provided regarding the development of recommendations.	Not stated.
New Zealand, 2013	The New Zealand Guidelines Group and University of Western Sydney conducted a literature review. Evaluation of the evidence based on criteria of the Australian National Health and Medical Research Council.	• A review of the literature as described • Assessment of relevant international guidelines • A review for the impact of sedentary behavior in the older's adult's health.	No information is provided on how experts meet consensus.	Not stated.
India,2012	Committee of experts summarized relevant evidence in a consensus statement document. No criteria for evaluating were described.	• Search under specific search keywords on PubMed • Manual searches • Adaptation of international guidelines if the evidence is not reported directly to Asian Indians.	Face to face meeting after a first draft was prepared.	Feedback provided on the first draft by experts. Modification by experts before the final publication.

Table 2. Details of the involved professionals, stakeholders and funding body of the clinical guidelines.

Country	Professionals involved	Target population	Stakeholders	Funding body	Competing interests
WHO, 2010	Experts from sport medicine, epidemiology, pediatrics, physiology, health promotion, policy-makers.	Three age groups. Special report to >65 age group.	National-level policy-makers.	Financial support through WHO/CDC Cooperative Agreements (2006/2010). UK funded the face-to-face meetings.	No conflict of interest was declared.
USA, 2018	Experts related to physical activity and health promotion or disease prevention.	Four different groups. Special report to >65 age group.	National-level policy-makers and health professionals, consumers and organizations that promote PA.	No payment, Committee worked under the regulations of the Federal Advisory Committee Act.	No conflict of interest was declared.
Canada, 2011	Experts in the fields of exercise physiology, social marketing, epidemiology, and physical activity Guideline-development.	Four age related groups (children, youth, adults, older adults). Special report to >65 age group.	Scientists, Guideline- developers, and potential guideline users.	Guidelines funded by the Canadian Society for Exercise Physiology and the Public Health Agency of Canada	No conflict of interest was declared.
Germany, 2016	Scientists from the fields of sports science, sports medicine and public health.	Four categories (children and adolescents, adults, older adults, adults with a chronic disease)	Numerous organizations involved in health promotion, physical activity and sport education, insurance, and policy-makers.	Funded by the Federal Ministry of Health on the basis of a decision by the German Bundestag.	Not stated
UK, 2011	International and national experts in the field of physical activity-epidemiology-behavioral, communications, academics and policy experts.	Four age related groups (early years <5, children and young people, adults and older adults) Special report to >65 age group	Professionals, practitioners and policymakers Communications Leaders, having a concern on the promotion of physical activity, sport, exercise and active travel.	Guidelines were issued by the Chief Medical Officers of England, Scotland, Wales and Northern Ireland.	Not stated
Australia, 2006	Four members of the Public Health Division, National Ageing Research Institute.	This specific document refers only to older adults including several population sub-groups	Consumers and health care providers (especially Department of Health and Ageing of the Australian Government)	Department of Health and Ageing, Australian Government.	Not stated
Netherlands, 2017	Multidisciplinary committee of Dutch experts.	3 age-related subgroups (children, adults, older persons).	General public, government, employers, Schools and health professionals.	Minister of Health, Welfare and Sport	Independent scientific advisory body
New Zealand, 2013	New Zealand 's Guidelines Group and the University of Western Sydney	Older adults >65 years old. Special report to population sub-groups.	Health practitioners, physical activity professionals and community fitness providers.	Ministry of Health	Not stated
India, 2012	National experts and experts from USA, UK and Australia in several fields (nutrition, exercise physiology, sports medicine, metabolic diseases, cardiology, internal medicine, endocrinology).	5 sub-groups (children and adolescence, healthy adults, pregnant and lactating women, elderly, population with Non-communicable Diseases). Special report to >65 age group.	Public policy makers.	Not declared but the Corresponding Author was Director and Head Department of Diabetes and Metabolic Diseases, New Delhi.	Not stated

guidelines. For calculating intensity several absolute or relative methods are introduced. Metabolic equivalent (MET) is used as a mean for calculating energy expenditure among people of different weight on an absolute scale. MET is the energy used at rest and is defined as 1 kcal/kg/ hour. A person's MET is three to six times higher when moderately active (3-6 METs) and more than six times higher when clinically active (>6 METs). The clinical guidelines from three countries[22,23,27] also provide information on light-intensity PA (1.6-2.9 METs). In New Zealand's[27] recommendations, energy expenditure was measured using both metabolic equivalent and a subjective self-rating energy scale (the Borg Rating of Perceived Exercise). This scale is based on physical sensations and person experiences during physical activity and is rated from 6 to 20, where 6 is no energy expenditure and 20 is maximum energy expenditure. On the other hand, WHO and USA's guidelines[2,22] defined moderate-intensity PA on a scale relative to an individual's personal capacity, as 5 or 6, and vigorous-intensity PA as 7 or 8 on a scale of 0-10. In India's[29] guidelines the calculation of light, moderate and vigorous PA is based on respiration rate.

Table 3. Clinical guidelines recommendations.

Country	Recommendations				
	Duration	Intensity	Frequency	Additional recommendation	Comments on sedentary time
WHO, 2010	75 - 150 minutes/week (depending on the intensity)for bouts at least 10 minutes duration	Vigorous to moderate or an equivalent combination.	At least 3 days/week to prevent falls; at least 2 days muscle-strengthening activities. Acute effects on biomedical markers for a PA in a daily basis.	More benefits increasing up to 300min/week moderate PA or 150min/week of vigorous PA or an equivalent combination. Stay active as current status allows.	Sedentary behavior contributing to disease risk profile require further investigation.
USA, 2018	75 to 300 minutes/week (depending on the intensity). Bouts at any length counts for meeting key guidelines.	Vigorous to moderate or an equivalent combination. Strong advice for engaging in multicomponent PA (multicomponent = aerobic, muscle-strengthening, balance training, dual task).	At least 3times/week	In frail older adults multicomponent, moderate-intensity programs for at least 3 times/week for 30-45 minutes/session over at least 3-5 months increase functional ability	Risk of sedentary behavior is dependent upon PA. Any reduction of sedentary time in older adults is beneficial
Canada, 2011	75 - 150 minutes/week (depending on the intensity) for bouts at least 10 minutes duration.	Vigorous to moderate or an equivalent combination.	Flexible daily routine.	More physical activity provides greater health benefits. At least 2 days muscle-strengthening activities in addition to 150min/week	Not stated for older adults.
Germany, 2016	75 - 150 minutes/week (depending on the intensity) for bouts at least 10 minutes duration.	Vigorous to moderate or an equivalent combination.	3 x 10 minutes/ day or 5 x 30 minutes/week.	At least 3 times/week balance exercises to prevent falls, muscle-strengthening physical activity at least two days per week, avoid sedentary time, increased volume (>150 minutes per week) and intensity leads to greater health benefits. Stay active as current status allows.	Older adults should avoid long and uninterrupted sitting times and should regularly interrupt sitting with physical activity whenever possible.
UK, 2011	75 - 150 minutes/week (depending on the intensity) for bouts at least 10 minutes duration.	Vigorous to moderate or an equivalent combination.	3 x 10 minutes/ day or 5 x 30 minutes/week.	Some physical activity is better than none. Gradual increases in the volume allow adaptation. At least 2 times/week balance exercises and muscle-strengthening for preventing falls. Avoid sedentary time.	All older adults should minimize the amount of time spent being sedentary (sitting) for extended periods.
Australia, 2006	At least 30 minutes/session.	Moderate intensity PA.	Daily	PA no matter the age, weight, health problems or abilities it should be implemented under safety procedures. Activity incorporate fitness strength balance flexibility, start at manageable level.	Physical inactivity is recognized as an independent risk factor for premature death.
Netherlands, 2017	150 minutes/week, bouts at least 10 minutes.	Moderate to vigorous intensity.	Several different days (at least five days a week).	Muscle strengthening at least twice/week with a combination of balance exercise. The more PA, the better.	A sedentary lifestyle is associated with a higher risk of NCD's and premature death, a link which is becoming weaker as PA is increased.
New Zealand, 2013	150 min/week, 30 min moderate intensity, 15 minutes vigorous intensity.	Moderate to vigorous or an equivalent amount of combined moderate- and vigorous-intensity activity.	5 days/week at least 30min moderate, bouts of 10 minutes.	2 times/week muscle strengthening, 3 times flexibility and balance exercises. The more physically active the merrier. Consultation of an appropriate health practitioner before starting or increasing physical activity.	Sedentary behavior or a lack of physical activity in older people can contribute to obesity. Obesity reduces life expectancy by 3 years and morbidity by 8-10 years.
India, 2012	At least 60 min/day with bouts of 10 minutes duration or 10-15 min periods of physical activity 2-3 times per day.	Moderate to vigorous activity.	30 min of moderate intensity PA, 15 min of work related activity and 15 min muscle strengthening.	Muscle strengthening 2days/week. Combination with balance training is the best way to reduce falling. Sudden starts or acceleration of PA should be avoided. For additional health benefits increase their moderate-intensity. The more PA the merrier. All decisions should be taken in consultation with a health professional.	In sedentary individual's progression of intensity is recommended.

Recommendations for PA

The key quantifiers used to determine the optimal PA are the duration, the intensity and the frequency[33,34]. Information on these variables is included in Table 3. For substantial health benefits a minimum duration of 150 minutes of moderate intensity aerobic PA or 75 minutes of vigorous intensity PA per week is recommended by the majority (seven out of nine) clinical guidelines. Clinical guidelines from the USA[22] suggest 150 to 300 minutes of moderate-intensity aerobic PA or 75 to 150 minutes of vigorous-intensity aerobic PA per week, spreading for at least 3 times throughout the week. Recommendations from the United Kingdom[25] proposed 3 times per day in bouts of 10 minutes or 5 times per week for 30 minutes. Australia's[26] guidelines provide general guidance and allow flexibility in the daily routine of PA. For extra health benefits from PA, time is set at 300 minutes per week by two guidelines[2,29] as USA[22] guidelines suggest active older adults engage beyond that threshold. The progressive nature of PA programs is also highlighted by 6 clinical guidelines[2,22,25-27,29]. However, choice of a specific duration is not always clearly justified or evidence based. Two guidelines[24,28] go a step further and clearly suggest consultation by an appropriate health practitioner before increasing PA for healthy older adults.

All clinical guidelines suggest moderate or vigorous intensity PA or an equivalent combination as a minimum recommendation. Seven out of nine clinical guidelines state that PA should be done at least in bouts of 10 minutes, whereas only clinical guidelines from Australia do not specify the minimum activity period. In the USA[22] guidelines is stated that bouts at any length add benefits on health, Regarding the frequency, daily physical activity is universally proposed, although clinical guidelines from WHO[2] and Germany[24] recommend a minimum of 3 times per week.

Falls Prevention

All clinical guidelines propose balance training for the reduction of the risk of falling and minimization of fracture risk. Four out of nine clinical guidelines[2,22,24,27] advocate balancing programs 3 or more times a week. USA's[22] guidelines promotes multicomponent PA (recreational activities and/or structured exercises programs) for reducing risk of falling and injury related to falls. The New Zealand's[27] guidelines provided the most detailed information regarding enhance balance and preventing falls in several parts of the document. In these guidelines the optimal intervention for enhancing balance includes either three 60-minute sessions of aerobic endurance activity per week over 4 to 52 weeks, or three sessions, each lasting 35 to 90 minutes, of multiple exercise resistance activity at varied intensities per week (timeline was not specified), or one to five 60-minute mobility and balance sessions per week over 4 to 52 weeks (intensity was not specified) or three sessions, each one lasting 30 to 60 minutes, of mixed or various physical activity over 4 to 52 weeks (intensity was not specified). Recommendation from the UK[25] suggests a balance training protocol twice a week while Dutch[27] clinical propose 2 to 3 days/week combined with aerobic exercises and strengthening. In Australia's[26] guidelines a dynamic protocol composed by 4-10 exercises with a progressive difficulty (decreasing the base of support as balance ability increases), focused on mobility and integration to daily routine with a flexible frequency (1 to 7 days per week) was recommended. In two of the guidelines[23,29] a simple statement about the benefits of balance training of falls prevention and frailty is included. Specific structured exercise programs such as the Otago Exercise, certain types of yoga and modified tai chi could prevent injury from falls especially in frail population[22,28].

Muscle strengthening for major muscles groups, 2 or more times per week, in addition to optimal dose of physical activity, is suggested by all clinical guidelines. Specific parameters for muscle strengthening are only indicated by USA[22] and UK[25] which suggest 8-12 repetitions for each muscle group as the optimal dose. In the USA's[22] guidelines it is also stated that 2-3 sets for each resistance exercise enhance muscle strength but elderly should take under consideration a warm-up and a cool-down phase for increasing effectiveness. Progression of exercises over time is essential for maximizing the benefits[22,25].

Expected Benefits

All clinical recommendation agree that greater PA levels equate to greater health benefits. The risk of injury or harm during all forms of physical activity remains small but appropriate safety procedures must be followed. Musculoskeletal injuries and acute cardiac events are considered as the main adverse effects. Interestingly, the incidence of injuries among older adults is lower than in younger people, as older adults do not attempt to perform activities with the same type of. Gradual increase of intensity of physical activity is the safest method for minimizing the risk of injury[2,22,25-27,29]. Applying moderate-intensity activities to start, with a progressive increase first in terms of activities duration, then in frequency and finally in intensity lead to increased benefits without side effects. Choosing the right PA and purpose definitely reduces the risk of injury. Taking precautions such as warming up and cooling down before and after exercising, or wearing appropriate shoes leads to an even greater reduction in adverse events as stated in the USA[22] guidelines. Considerations for urban planning (design open spaces for promoting small journeys), and transportation support (easy access to city centers) could also reduce the risk of all-cause injuries as well as increase physical activity in older adults[22,24,25]. Engaged in PA under supervision of a health care provider could minimize the relative risk[22,24,28]. A reference to air quality during activities is included is the USA's guidelines making a link *between* air pollution and adverse health events.

Seven out of the nine clinical guidelines make a statement about sedentary time as highlighted in the last column of Table

3. But these statements refer only to the increasing risk of premature death and development of chronic conditions, and obesity and do not provide specific recommendations on how to avoid it. In five guidelines[22,24,25,27,28] sedentary time refers to activities with energy expenditure of less than 1.5 MET. Activities considered as sedentary are sleeping. lying down, sitting, watching TV, reading, using a computer and travelling by car, bus or train as minimal muscle energy expenditure is required[22,25]. Devices which access movement or posture can potentially give an objective definition of sedentary time[22].

A special reference on methods and policies for promoting PA in the elderly is included in four out of nine guidelines[2,22,24,25]. These guidelines stated that PA could be promoted in many different levels from instinct-individual motivation to health professionals (individually or in small groups in generic or tailored exercise regimen) to community (families, friends, caregivers, policy-makers) as well as technology (devices that assess activity, e-health or m-health solutions, mixed reality platform for increasing motivation). Evidence based strategies could enhance adherence and monitoring could facilitate success. Promotion of PA especially in the elderly could be must more beneficial as gains could come faster than in any other age-related group.

Discussion

This review aims to identify and compare clinical guidelines on PA in older adults. We did not extend our analysis to other areas such as adults with health conditions and promotion of PA, as there were beyond the scope of the review, but we focused on falls due to their enormous and multidimensional impact. Nine clinical guidelines were included based on the inclusion criteria. The small number (n=9) of clinical guidelines included in this review highlights the highly need of an organized and well-structured effort by the vast majority of countries and global and/or national organizations to promote physical activity of older adults, despite the strong evidence proving its benefits to health, quality of life and socio-economic costs.

Details on methodology provided by six out of nine guidelines used a structured instrument (existing or customized) for grading and assessing data. Almost all documents were a result of a time-consuming but robust process even if the majority was based mainly on previous published reviews and guidelines. This underlines firstly the well-established data of beneficial effect of exercise in all ages, and especially older adults, and secondly the adoption of a common evidence-based rationale among the several organizations as the main scope of all documents is the promotion of well-being, the improvement of human health and most importantly the reduce of all-cause mortality risk. Thus, the main stakeholders of the guidelines are policy makers and health professionals in order to create the appropriate framework for motivating individuals to stay active and increasing acceptability in environments and situations which favor movement and encourage exercise.

The lack of extended source of references to population minorities, is an aspect that deserves special attention in the future for targeting PA actions in different cultures and in countries of low to middle income as highlighted by WHO's[2] guidelines. Only two documents provided a special report to population subgroups[26,27]. In the India's[29] guidelines an attempt was made to include data of the specific population (Asian Indians) but no details were given about the quantity and the quality of the included studies. Furthermore, more cost-effectiveness studies referring mainly to older adults, should be conducted to have a strong and clear outcome for interventions enhance mobility and preventing falls and chronic NCD's. Having a special interest in falls, a recently published systematic review provide evidence for supporting current best practice for falls prevention as cost effective treatment but the high heterogeneity of included studies does not allow meta-analysis. Even in that article, cultural barriers are highlighted[35].

Most of the national clinical guidelines included in this review, are consistent with the clinical recommendations provided by WHO[2], regarding definition of PA, duration, intensity and frequency of the PA in elderly, additional components with respect to balance, goals, adverse effects and benefits. In terms of dose-response analysis the 150 minutes of moderate-intensity aerobic PA per week seems to be the core of the recommendations towards meeting key guidelines. Duration could be modified depending on intensity (from 75 minutes of vigorous-intensity aerobic physical activity to 300 minutes of moderate-intensity aerobic PA per week for extra benefits). Optimal frequency is reported to be 3 times per week. Ideally a daily routine (5 times per week) leads to more health related benefits. Almost all of the recommendations referred that exercise should take place for at least 10 minutes in order to be effective. Contrary to this common statement, the USA's[22] guidelines urges that any duration of activity counts towards meeting guidelines. For elderly population, to stay as much active as possible is the main take-home message which is strongly emphasized in all documents. Even minimal PA is preferable as the sedentary behavior in the elderly is the biggest opponent of healthy ageing. Recommendation urges older adults to stay physically active but with cautions. Individual's health conditions and ability will determine the parameters of the activity. Thus consultation of a health professional is strongly advised and progression of different physical activity features must be structured without unexpected accelerations.

Highlighted benefits of PA included a reduced risk of falling as well as reduced risk of more than 26 chronic health conditions, increased life expectancy in good health, and increased quality of life, in addition to reduced risk of premature death and global mortality. The differences between the reviewed guidelines are minimal. A similar systematic review of clinical recommendations in European countries presents the same results for older adults and an agreement with the guidelines of the WHO[36].

There is strong evidence that the combination of muscle strengthening, balance, endurance and flexibility exercises minimizes falls risk in older adults[37,38] and seems that recommendation meet best current practice. A balance exercise protocol for three or more times per week and a muscle strengthening regimen targeting major lower limbs for at least 2 times per week are the minimum prerequisites for fall prevention. Session's duration could be flexible (from 35 minutes to 90 minutes) and depends on the weekly frequency. Progression over time is essential for more health benefits but also for adherence and motivation. Although the balance training component is an integral part of clinical guidelines for physical activity promotion in older adults, physical activity levels are rarely considered in the assessment and management of falls in this particular population[39]. Structured exercise programs such as Otago Exercise Programme[40] or popular activities (yoga – tai chi) or even recreational activities (dancing,gardening,sports)can be seen as possible options for improving balance as they can integrate individuals into a systematic and planned engagement, enhancing compliance.

Muscle strengthening exercises are included as general recommendations not only for preventing falls. The supporting evidence from the literature indicate that muscle strengthening increases lean body mass[41] and gait speed[42] in older adults; both features are strong risk factors for falls and risk of falling[43,44] but also has a sufficient impact on osteoarthritis[45], hypertension[46], and executive cognitive function[47]. In the guidelines 2 to 3 sets of 8-12 repetitions for all major muscles, 2 times per week increase benefits and particular mobility. The fact that only two of the guidelines[22,25] specify strengthening parameters suggests the insufficient data derives from the literature.

Despite the consistency of clinical recommendations provided by the guidelines, these have several limitations. General instructions and specific parameters related to exercise are given to a large extent satisfactorily as part of a dose response analysis, mostly as a guide, but they are not specified to such an extent that a specific protocol can be defined.

This is by definition problematic, since every older person should personalize the goals and benefits towards a more active life. However, further specification of activity variables will increase efficiency in individual, local and national level. The lack of this analysis is mainly due to the lack of reliability and validity of the objective outcome measures used to quantify PA.

Although personal devices like wearables are of a widespread use, no relevant recommendations have been identified. Dutch guidelines[27] noted that their use might be indicated in the future, however current evidence is not considered adequate to support a recommendation. A recent review[48] concluded among others that using accelerometers may lead to an inaccurate downward calculation of PA. Implementation of standardized objective measurements for promotion of PA in older adults required[49]. Nevertheless, even validated questionnaires, in spite of their subjective character, could also provide useful information assisting relevant decision making[50]. International Physical Activity Questionnaire, is widely used and recommended but a recent systematic review concluded that its short form had mild correlation with objective measures of PA[51]. Another barrier to ideally quantify PA is the variability in the reported results for specific physical activities. For example for walking, one of the most common forms of PA, several studies[52-55] propose different levels of intensity, translated in steps/day, in order to meet current recommendations thus it is difficult to propose common instructions. In the USA's guidelines[22] is stated that number of steps is not a guideline per se but a way to meet key guidelines.

Structured and group-based intervention is a reportedoption for overcoming hazards of cost, understaffing and long term adherence. Indeed group-based rehabilitation protocols enhanced mobility in frail older adults[56]. Supervised interventions contribute to increased compliance but long term efficiency imposes to be taken into account factors such as autonomy and relatedness[57]. For greater promotion of physical activity in the elderly, evaluation and inclusion of group and homed based intervention, as well as harmonization of the recommendations in different countries and specification of targeted interventions in special subgroups, a collaboration of stakeholders universally would be desirable.

Conclusion

The main purpose of this review was to assess and summarize the evidence and recommendations provided by clinical guidelines which refer to PA for older adults. A secondary aim was to review recommendations of PA regarding balance and reduction of falls. In general, the recommendations of all clinical guidelines were broadly consistent in terms of the level of minimum PA, forms of PA, proposed goals, and potential benefits. Definition of sedentary time, optimization of monitoring, quantification of physical activities, are some of the main topics to be addressed in the future. The universal need for promotion PA across regions and countries would be best served by collaborative actions across geographical borders mitigating cultural and behavioral differences. Such actions should involve all necessary stakeholders in order to set global common goals, promote guideline adherence and monitoring and would justify funding allocation.

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