Egyptian Rheumatology and Rehabilitation

RESEARCH

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The development of the Egyptian 24-h movement guidelines for adults aged 50 years and older: an integration of sleep, sedentary behavior, and physical activity by the Egyptian Academy of Bone and Muscle Health

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Abstract

Background With the vision of healthy aging, the Egyptian Academy of Bone and Muscle Health followed an established guideline development process to create the Egyptian 24-h movement clinical guideline for adults aged 50 years and older adults. This guideline highlights the significance of movement behaviors across the whole 24-h day. Online databases (PubMed, Embase, and Cochrane Library) were searched for relevant peer-reviewed studies that met the a priori inclusion criteria.

Results A total of 53 studies met the inclusion criteria. Leveraging evidence from the review of the literature led to the development of 27 statements answering the 5 key questions. Results revealed a major change in the previous basic understandings as it shifts away from focussing on a sole movement behavior to the combination of all the movement behaviors. Based on this, the final guideline was developed providing evidence-based recommendations for a "Healthy 24-Hour Day", comprising a mix of light-intensity and moderate-to-vigorous-intensity physical activity, sleep, and sedentary behavior.

Conclusion The developed guidelines are meant to help in the decision-making process and are intended for use by adults and older both nationally and internationally; also, for endorsement by the policy-makers. Dissemination and implementation efforts would impact positively on both health professionals and researchers and would also be useful to interested members of the public sector.

Keywords 24-h movement, Guideline, Osteoporosis, Falls, Physical activity, PICO, Functional ability, Quality of life, Healthy aging, Egyptian academy of bone and muscle health

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Background

Lack of physical activity has been linked to poor health and the development of various chronic illnesses with consequent potential disability in later life [1]. Despite these findings, it has been reported that nearly a quarter of people aged 50 years and older do less than 30 min of physical activity a week [2]. Musculoskeletal-wise, physical inactivity has a negative impact on both bone and muscle strength, reaction time, as well as endurance and posture. Concerning body organs, low level of physical activity is a well-known predisposing factor for several comorbidities including obesity, type II diabetes mellitus, hyperlipidemia, hypertension, coronary artery disease, stroke, and cancer particularly colon and breast cancer leading to premature death or disability [3]. At the supernational level, the World Health Organization (WHO) had estimated a yearly rate of two million premature deaths due to physical inactivity [4]. Although most of this data are from younger populations, other studies reported that this problem applies to older populations as well [2].

In the next Egyptian demographic transition, the number of elderly persons aged 60 + is expected to be more than twice as high between 2020 and 2050 from 8.4 million (8% of the total population) to 22 million (14%) [5]. In concordance with the industrial countries, a lack of physical activity has also been reported amongst Egyptian older adults. Earlier data revealed that less than 10% of the Egyptian population practice regular exercises, of them, the most inactive population were those over the age of 60 years old [6, 7]. The WHO report about physical activity in Egypt revealed that the prevalence of physical inactivity in Egyptian females over 70 years old was 55% whereas in men of the same age group was 35% [8]. Ageing is an evitable stage of life; therefore, it is important to have guidelines for physical activity which so far are not available in Egypt. With the vision of healthy aging, this work was carried out aiming to develop the Egyptian 24-h movement guidelines for adults aged 50 years and older with consideration of a balanced approach to sleep, sedentary behavior, and physical activity. These guidelines emphasize the significance of movement behaviors across the whole 24-h day.

Methodology

Study design

The framework used to develop the guidelines is consistent with the "Clinical, Evidence-based, Guidelines" (CEG) initiative protocol [9]. The methodology was designed to minimize bias, maximize transparency, and ensure high quality of the systematic reviews. The evidence-based component of the manuscript accommodated the preferred reporting items for systematic reviews and meta-analysis guidelines for reporting systematic reviews [10]. The project was an initiative led by the Egyptian Academy of Bone and Muscle Health.

Ethical aspects

This study was performed in accordance with the Helsinki Declaration. This was a multistep process that followed the "Clinical, Evidence-based, Guidelines" (CEG) initiative protocol, ethical approval code: 34842/8/21, ethical board Tanta University.

Core team

The core team provided an overview of the guideline development process, responsibilities, and timelines. The core team also drafted a set of research questions for each of the three behaviors: sleep, sedentary, and physical activity, as well as the integration of all these behaviors. The core team reached an agreement on the target Population, Intervention, Comparator and Outcomes (PICO) [11] (Table 1).

Literature review team

The evidence reviews were conducted by 2 experienced researchers and an expert in methodology. This depended on the identified research questions. The team addressed the gaps and generated the info for every behavior [12]. The articles search was carried out for the period from January 2000 till January 2024. The search keywords were identified based on different combinations of the PICO elements. Literature searches were carried out on 18th December 2023 for PubMed and Cochrane Library databases, and on 29th December 2023 for Embase. Duplicate screening of literature search results was carried out electronically. Further studies of relevance to the review were identified by an update of the review of the literature and from the lists of references of studies retrieved in the former initial database search. Recommendations regarding each section were provided by each of the experts in charge of the review of the literature, based on the evidence, when this was available, or on their own experience. The workgroup used the Oxford Centre for Evidence-based Medicine (OCEBM) system [13] to determine the level of evidence for each section.

Inclusion criteria

To be included in the current review, studies were required to meet the following criteria: (1) the study was published in an English-language, refereed journal with full-text availability; (2) the study contained original research (clinical guidelines, systematic reviews, randomized controlled trials (RCTs), uncontrolled trials, observational studies including cohort, case–control and cross-sectional studies); (3) the study included one

Table 1 Key questions for the 24-h movement guidelines and the patient/interventions, comparator/outcome (PICO) items identified for each movement behavior and used for the systematic review

Targeted population	Who are the targeted population?						
Goal setting	How to assess the subject's readiness to change in behavior?						
Movement behavior	Physical activity behavior		Sedentary behavior		Sleep Behaviour		Multicomponent physical activity
Stratified movement behaviour	Resistance training/ strength	Balance and functional training	Sedentary mode	Sedentary pattern	Sleep duration	Sleep pattern	Integration of the 3 behaviors
Key questions: the association between physical activity /behavior and health-related outcomes?	What is the impact of resistance training on health outcomes?	What are the health-related effects of balance and functional training?	What are the associations between modes and patterns of sedentary behavior with health outcomes?		What is the relation between sleep duration and pattern with health outcomes?		What is the association between integrated 24-h movement behaviors and health outcomes?
Intervention	A form of periodic exercise whereby external weights provide progressive overload to skeletal muscles in order to make them stronger and often result in hypertrophy	*Balance training: training aimed at improving postural control *Gait Training *Functional training: exercise that mimics the movements and tasks carried out in daily life, so it is based on task specificity	Objectively assessed or self-reported low-intensity activities (energy expenditure of ≤ 1.5 metabolic equivalents) in a seated, reclined, or supine posture	*Time/duration *Frequency *Bouts *Breaks Assessed using either subjective or objective measures	Duration of sleep per 24-h period This includes: *Nighttime *Naps Assessed using either subjective or objective measures	Using objective or subjective measures: *Time *Consistency	A multicomponent intervention program includes several elements, usually muscle strength, balance, flexibility, and endurance, and the time spent on each behavior
Comparison	*No intervention or placebo *Other forms: Intensity/ frequency/time *Other types of muscle training	*No intervention or placebo *Other forms: intensity/frequency, time *Other types of balance and functional training interventions	Other types of sedentary behavior	Other patterns of sedentary behavior			Different durations of time spent doing each behavior
Outcomes	Muscle strength Functional ability Quality of life All case mortality Adverse events	Falls Fractures Functional ability Quality of life Adverse events	Cognitive function Functional ability Quality of life Adiposity/body composition Cardiometabolic risk biomarkers		Cognitive function/mental health Functional ability Quality of life Falls Mortality Cardiovascular disease/type 2 diabetes		Cognitive function/mental health Functional ability Quality of life Falls Mortality Cardiovascular disease/ type 2 diabetes Adverse events Musculoskeletal pain
Monitoring	How to monitor the exercise program?						

or more assessment of each 24-h movement behavior, that is, physical activity, sedentary behavior and sleep; (4) to have a clearly described methodology including the PICO elements of the reviewed question.

Exclusion criteria

(1) Editorials, commentaries, conference abstracts, and non-evidence-based narrative/personal reviews were excluded; 2. Studies or clinical guidelines that referred only to admitted or hospitalized populations; 3. Studies or clinical guidelines that included populations other than adults or older adults.

Results

Review of the literature

The database systematic literature search yielded a total of 4987 relevant potential publications. Figure 1 shows the flowchart summarising the study selection process. After removing duplicates, 3813 records remained. After screening the titles and abstracts, 99 potentially relevant citations were obtained for full-text review. Of those, after completing the reading 51 studies met the inclusion criteria. Two additional citations relevant to this work were identified following an up-to-date search and those retrieved from the bibliography of the included articles. Therefore, a total of 53 studies published met the eligibility criteria and consequently were included in this work. These included nine clinical guidelines: WHO [14] (World Health Organization, 2010), USA [15] (Department of Health and Human Services, 2018), Canada [16] (Canadian Society for Exercise Physiology, 2011), Germany [17], United Kingdom–UK [18] (Department of Health, Physical Activity, Health Improvement and Protection, 2011), Australia [19], the Netherlands [20], New Zealand (Ministry of Health, 2013) [21] and India [22].

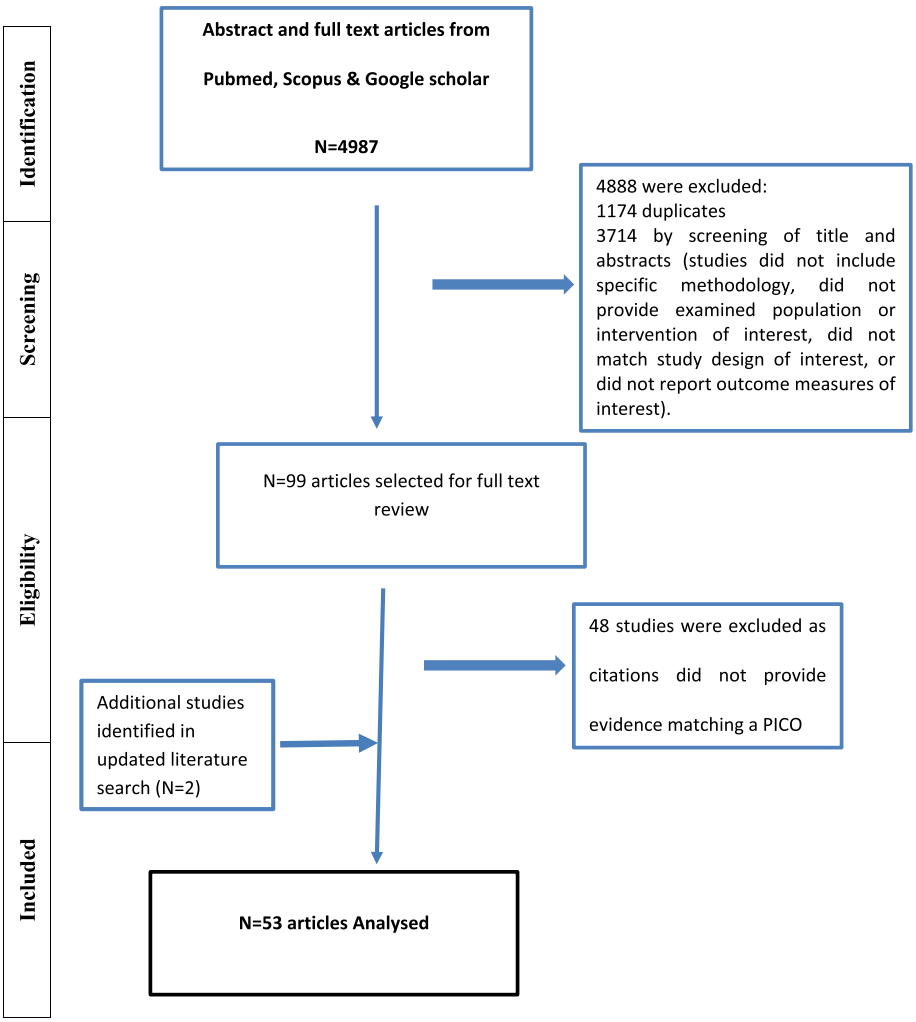

Fig. 1 Flow chart for the literature review and study selection process

Targeted population and guidelines development process

The targeted population included adults aged 50 years and older. The Egyptian Academy of Bone and Muscle Health was the organizing body. The professionals involved were experts in rehabilitation medicine, physical activity and health promotion, epidemiology, guidelines development, psychology as well as fall prevention. Consensus was achieved following multiple online meetings followed by online comprehensive feedback.

Results of the systematic review

The exercise prescription

This guideline provides evidence-based public health physical activity programs constructed in a systematic and individualized style in terms of frequency, intensity, time, type, volume, and progression that offer significant health benefits and mitigate health risks. This has been identified as the FITT-VP formula or principle. The FITT is a good approach to monitor the individual person's exercise program and progression. The parameters of the exercise prescription are shown in Table 2.

Baseline assessment and goal setting

The initial step to implement changes in the subject's physical activity is best predicted by evaluating the person's baseline activities and readiness to change. This should be carried out using an evidence-informed model with the goal of identifying: (1) the current level of exercise, (2) the presence or absence of asymptomatic/symptomatic known disease, and (3) desired intensity of exercise. Subsequently, the healthcare professional should educate the individual about the benefits of physical activity, changing some of the current behaviors, and motivate him/her with relevant personal goals, such as improving physical function or strength, balance, preventing falls, management of weight, improving chronic disease management, and preventing falls. Consequently, the individual should be able to agree with the healthcare professional on an initial set of achievable goals. Table 3 shows the developed Arabic Sedentary, Activity, Sleep Assessment (SASA) questionnaire, and associated explanatory figures for the assessment and monitoring of the exercise level of the individual subject (Supplement 1 shows the English copy of the SASA questionnaire).

Statements

Guided by the key questions, the systematic review was carried out to identify the effects of the 4 behaviors on the identified health outcomes. These are summarized in Table 4.

The Egyptian 24-h movement guidelines

Considering the overall health benefits, adults aged 50 years and older should be physically active every day, ensure sufficient sleep, and minimize sedentary behavior. Greater health benefits can be achieved by replacing sedentary behavior with extra physical activity and trading light physical activity for more moderate to vigorous physical activity, whilst continuing to have adequate sleep.

Overarching principles

- All persons 50 years and above should keep moving/physically active as much and as frequently as possible. They should practice physical exercises on a regular basis at least 5 days a week.
- Exercise programs should be customized to the individual's needs. No common exercise program can fit all.
- Individual's medical and physical status are considerable factors in choosing the parameters of the adopted exercise program.
- The heavier the exercise level, the greater the benefit. However, light-moderate physical activity is better than nothing.
- Benefits of physical activity included a reduced risk of falling and the potential to develop a fracture; also reduced risk of several chronic health conditions, provides longer healthy life span, improved quality of life, and reduced overall mortality rate.
- Sedentary behavior in the elderly is the biggest opponent of healthy aging.
- Whenever appropriate, daily physical activity is advised.
- Baseline assessments for functional ability, quality of life, sarcopenia, and falls risk are important and should be carried out for every older adult.
- The physical activity programs are dynamic and progressive in nature, including exercises with a progressive intensity focusing on daily mobility routine with a flexible frequency.
- Gradual increase in physical activity is the safest method for minimizing the risk of injury. The optimum approach is to start with moderate-intensity activities, with a progressive increase first in terms of activity duration, then in frequency, and finally in intensity. This would lead to increased benefits with a low incidence of side effects.
- Physically inactive people but otherwise healthy and asymptomatic may start with light- to moderate-intensity exercise. In the absence of symptoms,

Table 2 Definitions of the exercise prescription for adults and older adults. The physical activity program should be designed in a systematic and individualized style in terms of frequency, intensity, time, type (FITT), volume, and progression. Older adults should engage in a combination of aerobic, resistance, flexibility, and balance training to promote and maintain health

Physical inactivity	**No activity except baseline daily activities**				
Sedentary behavior	Activities considered sedentary are sleeping. lying down, sitting, watching TV, reading, using a computer, and traveling by car, bus, or train as minimal muscle energy expenditure is required				
Physical activity	Any body movement produced by skeletal muscles that requires substantial energy expenditure above and beyond resting energy expenditure and produces progressive benefits to health and functional capacity without undue harm and/or risk				
Physical activity					
	Sedentary	Light intensity	Moderate intensity	Vigorous intensity	
Definition	Any waking behavior while in a sitting, reclining, or lying posture	moving rather than sitting or lying down	Will make breathing faster and raise the heart rate and feel warm (simply the person can not sing, but can talk	Will make the breathing fast and hard with fast heartbeats (the person will not be able to say more than a few words without pausing for breath)	
Examples	Sitting, reclining, or lying down	Making the bed or a cup of tea, standing up, moving around the home, dusting or cleaning, walking at a slow pace vacuuming	Water aerobics, walking for health, bike riding, dancing for fitness, playing doubles tennis	Aerobics, martial arts, running, fast bike riding or on a hill, swimming, playing singles tennis or football, dancing for fitness	
Frequency (How often?)	Muscle strengthening		Balance and functional Ability	Multicomponent activities	
	2 or more days a week		3 or more days a week	3 or more days a week	
Intensity: (how hard) physical activity Intensity assessment:					
Absolute measure using: metabolic equivalent (MET)	< 1.5 METs	1.6–2.9 METs	3–6 METs	> 6 METs	
Relative: visual analog scale (VAS 0–10)	Sedentary	Light intensity	Moderate intensity	Vigorous intensity	
	0– < 2	2–4	5–6	7–8	
Time (durations) (how long?)	Moderate Intensity		Vigorous Intensity	Balance and functional ability	Sleep
	150–300 min/week		70–150 min/week	60 min 2–3 times/week	7–9 h/day
Type of exercise (what kind?):					
Aerobic physical activity	"Activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Aerobic activity—also called endurance activity—improves cardiorespiratory fitness. Examples include walking, running, swimming, and bicycling" [14]				
Example of an aerobic activity program	Frequency: at least 5 times a week Intensity: 5 min of warm-up, more vigorous exercise then 5 min of cool-down Type: The activity that increases the heart rate and to be done continuously for at least 10 min Duration: 30 min per day 5 days a week is preferred				
Balance training	"Static and dynamic exercises that are designed to improve an individual's ability to withstand challenges from postural sway or destabilizing stimuli caused by self-motion, the environment or other objects" [14]				
Bone-strengthening activity	"Physical activity primarily designed to increase the strength of specific sites in bones that make up the skeletal system. Bone-strengthening activities produce an impact or tension force on the bones that promote bone growth and strength. Examples include any type of jumps, running, and lifting weights" [14]				
Example of a resistance exercise program	A well-designed resistance training exercise should work towards 2–3 sets of 1–2 multi-joint exercises per major muscle group, for 8–12 repetitions, achieving moderate intensities (40–60% of 1 repetition maximum) to high intensities (70–85% of 1 repetition maximum), 2–3 times weekly				
Volume	- If moderate intensity: ≥ 150 min/week - If vigorous intensity: ≥ 75 min/week				
Progress (progress volume and reach)	Progression may be individualized based on tolerance and preference in a conservative manner - If moderate intensity: total 60 min/day, 300 min/week - If vigorous intensity: total 30 min/day, 150 min/week				

Table 3 The sedentary, activity, sleep self-assessment questionnaire for the evaluation and monitoring of the exercise level of the individual person

التقرير الذاتي لتقييم النشاط المستقر والنشاط البدني وجودة النوم

أ- نمط الحياة المستقر الوقت اليومي الذي أقضيه في الجلوس أو الاستلقاء	٠	١	٢
١. الوقت الذي أقضيه في مشاهدة التلفاز أو الاستماع إلى الراديو أو القراءه	أقل من ٤ ساعات	من ٢- ٤ ساعات	أكثر من ٤ ساعات
٢. الوقت الذي أقضيه أثناء الاستلقاء (لا يشمل وقت النوم)	أقل من ٤ ساعات	من ٢- ٤ ساعات	أكثر من ٤ ساعات
٣. الوقت الذي أقضيه على هاتفي المحمول	أقل من ٤ ساعات	من ٢- ٤ ساعات	أكثر من ٤ ساعات
٤. الوقت الذي أقضيه في ممارسة الأنشطة الترفيهية أثناء الجلوس	أقل من ٤ ساعات	من ٢- ٤ ساعات	أكثر من ٤ ساعات
ب. النشاط البدني أمارس النشاط البدني بانتظام	٠	١	٢
٥. عدد مرات ممارسة النشاط البدني	نادرا ما أفعل ذلك أو لا أفعله أبدا	أقل من ٣ أيام/أسبوع	٣-٥ أيام/أسبوع
٦. شدة النشاط البدني	نادرا ما أفعل ذلك أو لا أفعله أبدا	أمارس بعض الأنشطة البدنية الخفيفة أو المعتدلة	أمارس نشاطًا بدنيًا قويًا
٧. وقت النشاط البدني	لا يوجد أو لبعض الوقت أحيانا	يستمر تمريني ٢٠- ٣٠ دقيقة في اليوم	يستمر تمريني لأكثر من ٣٠ دقيقة في اليوم
٨. نوع النشاط البدني	لا يوجد	أمارس نوع واحد فقط من التمارين، على سبيل المثال: التمارين الهوائية	يتضمن روتيني تمارين متعددة الوسائط، مثل التمارين الهوائية والتقوية والتوازن
ج. جودة النوم	٠	١	٢
٩. عادة ما انام	بعد ٢ صباحا	عند منتصف الليل	١٠ مساءا
١٠. عادة ما أنام	أقل من ٥ ساعات	من ٥- ٧ ساعات	من ٧- ٩ ساعات
١١. أستطيع أن أستغرق في النوم خلال	أكثر من ساعة	٣٠- ٦٠ دقيقة	أقل من ٣٠ دقيقة
١٢. أستيقظ في منتصف الليل.	أكثر من مرة	مرة واحدة	ولا مرة
١٣. عادة ما أعاني من صعوبة في التنفس أو انقطاع التنفس أو الشخير بصوت عالٍ	نعم	غير متأكد	لا
١٤. أتناول أدوية موصوفة أو بدون وصفة طبية لمساعدتي على النوم	كثيرا	أحيانا	لا اتناول

حساب المؤشر

نمط الحياة المستقر	**كسول** ٢-٠	**غير نشط** ٤ -٢<	**نشط** ٤<
النشاط البدني	**غير نشط** ٢-٠	**أقل من نشط** ٦ -٢<	**نشط** ٦<
جودة النوم	**جودة النوم رديئة** ٣-٠	**جودة النوم متوسطة** ٩> -٣<	**جودة النوم جيدة** ٩ -١٢

Table 4 Statements concluded from the systematic review for each of the movement behaviors identified and their level of evidence

Movement behavior	Statements	Evidence
Resistance training	*Improved muscle strength and physical functioning [23, 24]	B
	* No effect on quality of life [25]	C
	*Reduction in Cardiovascular incidents in men [26]	C
	*Lower risk of all-cause mortality [27]	C
	* Infrequent serious adverse events [27]	D
	* Insufficient data to indicate whether age has modified the resistance training impact on health outcomes [28] Conclusion: The benefits of resistance training outweigh the harms	D
Balance and functional training	* Reduced the falls rate [5]	A
	* Reduced fall-related fractures [29]	C
	* Improve physical function and increase physical activity levels	B
	* No effect on health-related quality of life	C
	* Infrequent serious adverse events	B
	* Insufficient data to indicate whether age has modified the balance and functional training impact on health outcomes [5] Conclusion: the benefits of balance and functional training outweighed the potential harms	D
Sedentary behavior	* Significant association between greater time spent in sedentary behavior and both higher all-cause mortality rates and higher mortality rates from cardiovascular disease [30]	A
	*Negatively associated with cognitive function, depression, functional ability, physical activity levels, and some domains of quality of life	B
	* Breaking up or reducing sedentary behavior has more favorable levels of several critical and important health outcomes. Also, may benefit body composition and markers of cardiometabolic risk [31]	C
	* Unfavourable health outcomes were most consistently associated with total sedentary behavior and TV viewing, whereas there was evidence that computer and Internet use may lead to benefits in cognitive function particularly in older adults	C
	* Small evidence to indicate that sedentary behavior is related to musculoskeletal pain, injuries or accidents, or fatigue [31]	C
Sleep	*Sleep duration of around 7–8 h per day is most favourably associated with critical health outcomes [32]	A
	*There is "U" shape association between sleep duration and health outcomes	B
	*Later sleep timing and greater sleep variability are generally associated with more adverse health outcomes (no thresholds for "late sleep timing" or "large sleep variability" have been identified) [33]	C
	*Social jetlag (misalignment of biological and social time) has been related to more adverse health outcomes [34]	C
	*Weekend catch-up sleep was associated with better health outcomes [33]	C
	*Regularity in sleep patterns and earlier sleep timing with consistent bedtimes and wake-up times have been favorably associated with Health [5]	C
Integrated movement behaviors	* Across the 24-h, the composition of movement behaviors is associated with health outcomes [34]	A
	*Combination of muscle strengthening, balance, endurance, and flexibility exercises minimizes falls risk in older adults	A
	* The 24-h movement behavior composition has been associated with all-cause mortality, adiposity, and cardiometabolic biomarkers	B
	* Unfavourable health outcome if time was taken out of the vigorous physical activity to be allocated for sedentary or sleep activity, whereas the health outcome gets favorable if the time has been reallocated to vigorous physical activity	D
	*Health would also improve if time were taken out of sedentary behavior and reallocated into sleep or low physical activity [34]	D

they should progress gradually as advised by the exercise prescription guidelines.

- Progression of physical activity over time is not only important for more health benefits but also for motivation and adherence.
- Active older adults may engage in physical activities beyond the identified thresholds.
- Consulting an experienced healthcare professional/practitioner is advisable before increasing the physical load is recommended for healthy older adults.

- Multicomponent physical activities integrating many types of exercises (strengthening, endurance, and balance exercises) are advised.
- Injuries and adverse effects during all forms of physical activity are negligible, however appropriate safety practices must be ensured.
- Structured and group-based intervention/rehabilitation is advised for improving motivation, reducing cost, understaffing, and improving long-term adherence.
- The guidelines and physical activities advised should be promoted at several levels individual, family, community, caregivers, technology, and policymakers.
- No current recommendations support the use of personal devices such as wearables

Guidelines

To achieve a healthy 24-h, adults aged 50 years or older should:

General elderly population

1. Physical activity

1.1 Aerobic training:

- Thirty to 60 min a day of moderate-intensity aerobic activity at least 5 days/week; or
- Fifteen to 30 min a day of high-intensity aerobic activity at least 5 days/week; or
- an equivalent mix of moderate- and high-intensity aerobic workouts all around the week.

1.2 Resistance training:

- Non-consecutive 2 to 3 days a week of resistance training should be recommended.
- Each exercise should include 2–3 sets of resistance exercises working on multi-joint exercises per major muscle group and of intensity equal to 70–85% of 1 repetition maximum (1RM).
- Performing the muscle strengthening exercises in the positions and forms of real-life daily activity movements is prescribed as functional strengthening exercises. This type of exercise is recommended as well as regular strengthening exercises.

1.3 Balance training:

- Practicing of 30 min balance endurance exercises 2–3 times a week is recommended.
- Combined static and dynamic balance training should be practices

2. Sedentary behavior:
   All adults including older adults are advised to decrease their sedentary time and push their bodies to move as frequently as possible; therefore, the individual should:
   - Limit the amount of time spent being seated.
   - Replace inactive time with any kind of physical activity of any intensity (including light intensity)

3. Sleep:
   - Ensure appropriate sleep duration (7–9 h) and sleep consistency (good-quality sleep, with going to bed and getting up at the same time)
4. Integrated behavior:
   All adults and older adults are advised to practice regular frequent multicomponent physical training exercise that involves a combination of aerobic, strengthening, and balance exercises in different levels of intensity. This is besides decreasing the inactive time and ensuring good sleep quality.

Elderly people with special conditions

1. People with chronic conditions

Among older adults, chronic comorbidities and illnesses such as cancer, obesity, diabetes, cardiovascular, hyperlipidemia, and arthritis are the leading causes of death and/or disability among older adults [35]. There is no direct evidence of specific sedentary behavior for these subpopulations. Hence, the evidence for sedentary behavior recommendations for general populations remains applicable to them [14]. On the other hand, special precautions should be considered when offering an exercise prescription for those patients with chronic conditions. Table 5 shows the suggested exercise prescription modifications and special considerations and physical activity recommendations for patients with specific medical conditions.

2. Patients at high risk of fragility fracture

- Strict caution should be practiced when prescribing moderate (e.g., running, racquet sports, skipping) or high (e.g., drop or high vertical jumps) impact exercise for these patients.
- Safety or efficacy is questionable in individuals with a history of fractured vertebrae or Major

Table 5 Exercise prescription modifications and special considerations and physical activity recommendations for patients with specific medical conditions

	Frequency	Intensity	Time	Type	Tips
Healthy older adults	Moderate intensity: ≥ 5 days/week Vigorous intensity: ≥ 3 days/week	Moderate to vigorous 8–10 exercises, ≥ 1 set of 10–15 repetitions	Moderate intensity: ≥ 30 min/day to total 150 min/week Vigorous intensity: ≥ 20 min/day to total 75 min/week	Aerobics	*Strengthening muscle exercise > 2 days/week, non-consecutive *Flexible program: ≥ 2 days/week at least 10 min/day
Diabetes mellitus II	3–7 days/week	Moderate to vigorous	10–30 min/day to total 150 min/week Progress to ≥ 300 min/week	Aerobics Resistance training at moderate to vigorous intensity twice per week on non-consecutive days 8–10 exercise; ≥ 1 set of 10–15 repetitions *Flexible program: ≥ 2 days/week at least 10 min/day	*No more than 2 consecutive days of aerobics between bouts of activity *If the person is receiving insulin therapy, decrease the medication dose before, during, and after the exercise *take carbohydrates if your blood glucose level is less than 100 mg/dL (5.5 mmol/L) before the exercise
Hypertension/cardiovascular disease	5–7 days Preferably all the weekdays	Moderate	30–60 min/day	Aerobics * Strengthening muscle exercise ≥ 2 days/week, non-consecutive * Resistance training at moderate to vigorous intensity twice per week on non-consecutive days 8–10 exercise; ≥ 1 set of 8–12 repetitions	*Flexible program: > 2 days/week at least 10 min/day *For patients with peripheral vascular occlusive disease, exercise should be limited to pain tolerance each session to extend time to claudication *Stress testing is recommended before vigorous exercise training in patients with CVS disease
Obesity	5–7 days	Moderate to vigorous	10–30 min/day to a total of 150 min/week Progress to ≥ 300 min/week	Aerobics Resistance training at moderate to vigorous intensity twice per week on non-consecutive days 8–10 exercise; ≥ 1 set of 10–15 repetitions, especially during weight loss period to help maintain lean muscle and bone mineral density	* Flexible program: > 2 days/week at least 10 min/day
Hyperlipidemia	> 5 days/week to enhance cardiac performance	Moderate	30–60 min/day	*Aerobics *Resistance training at moderate to vigorous intensity twice per week on non-consecutive days 8–10 exercise; > 1 set of 10–15 repetitions	* Flexible program: > 2 days/week at least 10 min/day

Table 5 (continued)

	Frequency	Intensity	Time	Type	Tips
Arthritis	3–5 days/week	Light to moderate Very light if dysfunctional or deformed	Short bouts of 10 min/day increasing as tolerated to 30 min/day to total 150 min/week	*Aerobics *Resistance training at moderate to vigorous intensity twice per week on non-consecutive days 8–10 exercise; > 1 set of 10–15 repetitions	*Land or aquatic-based physical activity *Flexible program: > 2 days/week at least 10 min/day *Aerobic and lower limb strengthening exercises can alleviate Osteoarthritis joint pain and improve function
Pulmonary disease	5–7 days/week	Moderate	30 min/day To be timed to coincide with the bronchodilator medication peak	* Usually as a part of the pulmonary rehabilitation program (usually over 6–12 weeks) *Aerobics	Use oxygen during exercise as needed

osteoporotic fracture FRAX score of 15% calculated by the Egyptian FRAX.
- The most dangerous movements especially for those with vertebral fracture are those that entail flexion and twisting of the spine or rapid, repetitive, sustained, weighted, or end range of motion

3. Frail adults/older adults

- Multicomponent exercise program including progressive resistance training works well for frailty fighting.
- Before prescribing the exercise dose, measuring aerobic fitness by cardiopulmonary exercise testing is recommended to determine exercise tolerance.
- Progression or regression of exercise intensity is dependent on the person's tolerance and general condition is recommended according to the person's tolerance and health condition.
- Resistance training has better results if accompanied by the intake of the proper amount of protein.
- Specific structured exercise programs such as modified tai chi or certain types of yoga could prevent injury from falls.
- Supervised, group-based exercising protocols are advised as they may enhance motivation and adherence
- Homed-based and even bedside exercises are possible options to promote physical activity in very frail old adults.

Table 6 shows a summary, with examples of the Egyptian "Healthy 24-Hour" movement guideline.

Discussion

Preceded only by tobacco use, hypertension, and high blood glucose levels, physical inactivity was categorized as the fourth leading risk factor for noncommunicable diseases [36, 37], triggering about 41 million deaths annually (correspondent to 74% of all deaths globally) [38]. New research studies recommend that the structure of movement behaviors within a 24-h period may have a strong effect on health across the lifespan. Consistent with this paradigm of integrated movement behavior, the WHO as well as several countries across the world have developed "24-h movement guidelines" for different age groups. The purpose of this work was to develop "the Egyptian 24-h movement guidelines" for adults 50 years and older. This document is proposed for use by policymakers, health professionals, researchers, and interested individuals. Figure 2 shows the logo of the proposed national campaign. This 24-h movement guideline is relevant to all Egyptians aged 50 years or older, irrespective of gender, socio-economic status, or cultural background. The guideline development process adhered to the "Clinical, Evidence-based, Guideline" framework used to develop previous national guidelines in Egypt [9].

The principal concept of the developed 24-h movement guideline is that the structure of all movement behaviors throughout the day is strongly correlated to the individual's health, and delivers exclusive, evidence-based opportunities to participate in movement behavior integrations that meet the individual's requirements and personal preferences. This comes in agreement with the previously published 24-h guidelines published by the WHO and 8 other health authorities worldwide [14, 15, 17–22]. This paradigm represents a major change in the previous basic understandings, as it shifts away from focussing on a sole movement behavior to the combination of all the movement behaviors. In turn, this endorses the growing body of evidence advocating that the mix of movement behaviors over a 24-h day impacts a wide range of health outcomes [39–42].

The disengagement from any form of physical activity is not only prevalent in Egypt. In fact, it is an international challenge. Whilst 35% of older adult men and 55% of women have been reported as physically inactive, more than 40% of the adult European population do not engage in any form of physical activity, and only 8% regularly exercise [43]. Sedentary behavior and physical inactivity are directly linked to increased prevalence of cardiovascular disease [44], obesity, diabetes [45], and autoimmune rheumatic diseases [46]. WHO data [8] indicate that 86% of deaths in Egypt are due to non-communicable diseases (NCDs) mortality, with cardiovascular disease followed by cancer being the main causes on top of the list. This highlights the importance of having a national 24-h movement guideline in Egypt, particularly, increasing levels of physical activity have been reported as a catalyst in the reduction of the above consequences.

In concordance with the earlier published guidelines [5, 29], the developed Egyptian 24-h movement guideline, revealed similar physical activity components for both adults and older adult age groups. Demographic data from Egypt reveal that life expectancy at birth for men is 68.5 years whereas for women it is 73.2 years. Results of a recent study in Egypt revealed that patients aged 50 years and older are at higher risk of falling and sustaining a fragility fracture [47]. This was the reason for including Egyptian adults aged 50 years and older in this guideline. However, this guideline may not be appropriate for adults aged 50 years or older living with a disability or a medical condition; these individuals should

Table 6 The Egyptian Guidelines for A "Healthy 24-Hour" movement

Behavior	Physical activity				Sedentary behavior	Sleep
Recommendation "1"	Accumulation of at least 150 min per week of Moderate to vigorous aerobic physical activities				Limiting to 8-h or less	7–9 h of good-quality sleep
Examples	Examples of weekly programs				This should include: -No more than 3 h of recreational screen time -Movement breaks: Breaking up long periods of sitting as often as possible	On a regular basis with consistent bed and wake-up times
Moderate-intensity aerobic activity (e.g., brisk walking) for 150 min (for example, 30 min a day, 5 days a week)	Moderate intensity bouts at least 10 min duration, 3 times/day, making up for 30 min a day, 5 days a week	Interval walking training: repeating five or more sets of 3 min fast walking at 70% peak aerobic capacity for walking (w) per day with intervening 3 min slow walking at 40% w, for 4 days/week, for 5 months	Vigorous-intensity aerobic activity (e.g., jogging or running) for 75 min (1 h and 15 min) every week (can be spread over 3-times throughout the week	An equivalent mix of moderate- and vigorous-intensity aerobic activity on 2 or more days a week		
Recommendation "2"	Plus: Muscle-strengthening activities					
Description	on 2 or more days a week that work all major muscle groups (legs, hips, back, abdomen, chest, shoulders, and arms)					
Examples	Exercises where major muscle groups (e.g., upper and lower extremities, chest, shoulders, back) work against resistance (e.g., squats, lunges, and push-ups). Increase volume (e.g., sets, reps, weight), frequency, or difficulty to achieve progressive overload A warm-up and a cool-down phase are advised to increase the effectiveness Session's duration could be flexible (from 35 to 90 min) and depends on the weekly frequency 8–12 repetitions for each muscle group can be considered as the optimal dose Progression of exercises over time is essential for maximizing the benefits Many resistance training exercises would be considered functional exercises Wearing appropriate clothes/shoes can help to reduce adverse events					
Recommendation "3"	Plus: Balance and functional activities					
Description	Exercises that challenge aspects of balance on 3 or more days a week, for 60 min 2–3 times/week					
Balance exercises	· Shifting body weight to the limits of stability • Reacting to things that upset your balance (e.g., catching and throwing a ball) • Maintaining balance while moving (e.g., Tai chi, heel raises, agility training) • Reducing base of support (e.g., standing on one foot)					
Functional activity exercises	· Exercises that improve the ability to perform everyday tasks or do activities for fun or fitness · Structured exercise programs such as popular activities (yoga–tai chi) or recreational activities (dancing, gardening, sports) are possible options for improving functional ability and balance · Other examples: chair stands for sit-to-stand ability, stair-climbing to train for hiking)					

Fig. 2 The logo of the proposed national campaign in Egypt: Movement is a blessing "الحركه بركه" composed of 4 s (strong, step, sit, and sleep)

seek advice from their treating health professional for guidance. The guidelines are meant to help in the decision-making process but do not clarify all uncertainties of patient care. Although adopting this guideline can be challenging at times; progressing towards any of the targets identified in this guideline will result in some health benefits.

These guidelines stated that enhancing physical activities among adults and older adults should be promoted at different levels. This can be at the individual level, based on instinct-individual motivation; or community-based (families, friends, caregivers, policy-makers), or health professionals (individually or in small groups in generic or tailored exercise regimen) to technology (devices that assess activity, e-health or m-health solutions, mixed reality platform for increasing motivation). A logo (Fig. 2) has been developed by the Egyptian Academy of Bone and Muscle Health to spread the word and enhance the involvement of Egyptian adults and older adults at a national level. Evidence-based strategies could enhance adherence and monitoring could facilitate success.

In conclusion, there is a large body of evidence for the benefits of physical activities for healthy aging, and this is expressed in the development of several guidelines for different health conditions that stress the importance of incorporating physical activities for adults and older adults. This is endorsed by the fact that promoting physical activity, particularly in older adults could be more beneficial as health gains could come faster than in other age groups. physical inactivity results in limitations in body functioning and mobility and reduces the opportunity for independent living in later life. Physical activity in both adults and older adults, regardless of chronic disease, was reported to be associated with delayed physical disability and the maintenance of independent living. The developed Egyptian 24-h movement guideline endorses the recommendations for physical activity, sedentary behavior, and sleep which should be combined into a single public health domain that incorporates movement across the full 24-h day. A national campaign should be launched under the title "Moving more make your life matter".

Abbreviations

BMD	Bone mineral density
FRAX	Fracture Risk Assessment
NCDs	Non-communicable diseases
PICO	Population, Intervention, Comparator and Outcomes
RCT	Randomized controlled trials
WHO	World Health Organization

Supplementary Information

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Additional file 1: Supplement 1. Self-reported sedentary, physical activity and sleep quality assessment questionnaire for the evaluation and monitoring of the exercise level of the individual person.

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Prof. Safaa Mahran and Yasser El Miedany are from the editorial board of the journal. All other authors declare that they have no competing interests.

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