

Twenty-Four-Hour Movement Practice Guidelines for Saudi Arabia

An Integration of Physical Activity, Sedentary
Behavior, and Sleep Duration



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FOREWORD

At the core of our aspirations to build a resilient Kingdom is the recognition to support the continuing development of our biggest and most precious asset -the citizens of our great nation- whether young or old. In order to provide the best future for our population, at whatever age that might be, we need to start with the fundamental pillar that lays the foundation for a successful future health.

Since the initiation of the National Vision 2030, several sectors have been collaborating to prioritize the essential aspects that directly affect the quality of life that enhances an optimized life experience from birth to end of life.

These elements encompass the key building blocks for individuals from our environment, where we live, access to essential services, and opportunities to support every citizen and resident. These elements benefit not only individuals and communities, but are also essential to sustain a vibrant and strong future.

We are bringing together the best available knowledge we have internationally and nationally to produce a series of best practice guidelines. These are aimed at multisectorial professionals who should adapt and use them in their practice.

The 24-hour movement guidelines demonstrate how fundamental changes to the way we understand the key links between physical activity, sedentary behavior and sleep duration have an impact on mental health, physical health, and well-being, and our ability to strive and achieve the best that life can offer.

If we are to achieve our best lives and thrive, then our aim is to prevent physical and mental illnesses by supporting the development of best practice models where we can influence and provide support for conscious and mindful decisions around healthy living.

This means that treatments can be reserved for those with unavoidable illnesses and conditions.

This is only one part of a complex picture that constitutes the components needed for individuals and communities to thrive. It complements the ongoing efforts made in partnership to support our people and communities, to enable everyone to live longer, healthier, happier, and ultimately more fulfilling lives.

Dr. Tawfig AlRabiah

Minister of Health



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LIST OF ABBREVIATIONS

AASM	American Academy of Sleep Medicine
AGREE II	Appraisal of Guidelines for Research & Evaluation II
BMI	Body Mass Index
CHD	Coronary Heart Disease
GRADE	Grading of Recommendations Assessment, Development and Evaluation
MET	Metabolic Equivalent
MOH	Ministry of Health
NCD	Non-Communicable Disease
NREM	Non-Rapid Eye Movement
NSF	National Sleep Foundations
PBUH	Peace Be Upon Him
PG	Practice Guidelines
QoL	Quality of Life Program
RAM	RAND Appropriateness Method
RCT	Randomized Controlled Trial
REM	Rapid Eye Movement
SRS	Sleep Research Society
UK	United Kingdom
US	United States
WHO	World Health Organization



GLOSSARY OF TERMS

Adolescents	Individuals in the 13–17 years of age.
Conditional recommendation	Defined as the recommendation proposed when the panel infers that the desirable effects of adherence to the recommendation probably outweigh the undesirable effects, but the panel is not confident about these trade-offs.
GRADE ADOLOPMENT	A methodology that combines the advantages of adoption, adaptation, and de novo development of recommendations (“GRADE ADOLOPMENT”) based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Evidence to Decision frameworks.
GRADE Recommendation System	The GRADE system describes two levels of evidence: strong and conditional.
Good quality sleep	According to the National Sleep Foundation, good sleep includes falling asleep in 30 min or less, sleeping more than 85% of the total time in bed, being awake for 20 min or less after initially falling asleep, and waking up refreshed.
Light activity	Includes standing up and moving around in the home, workplace or community. Energy expenditure is 1.6 to 2.9 metabolic equivalent (METs; on a scale from 1 to 10). Examples include walking to the mosque or shopping.
Moderate physical activity	Refers to physical activity that is performed at 3.0 – 5.9 METs (on a scale from 1 to 10). Physical activity at a moderate intensity increases breathing rate and heartbeat and may make you sweat. Examples include brisk walking, jogging, and gardening.



GLOSSARY OF TERMS

Moderate-to-vigorous aerobic activity	Refers to physical activity that includes moderate and vigorous intensities (>3.0 METs). Examples include activities such as playing football, other team sports, and swimming.
Napping	Refers to a daytime sleep. It is a frequent habit in many persons, whether healthy or not, and it may take cultural and religious dimensions and may occur in a wide variety of settings. When talking about napping, it is essential to determine the duration and timing.
Optimal health	Refers to the healthy functioning of various body organs and normal cognitive and daytime functions.
Prolonged sitting	Accumulating sitting time in extended continuous bouts.
Sedentary behavior	Any waking behavior characterized by an energy expenditure of ≤ 1.5 metabolic equivalents of a task while in a sitting, reclining, or lying posture.
Strong recommendation	Defined as the recommendation proposed when the panel is confident that the desirable effects of adherence to the recommendation outweigh the undesirable effects.
Vigorous physical activity	Refers to physical activity that is performed at ≥ 6.0 METs on a scale from (1 to 10). Physical activity at vigorous intensity may include aerobic and anaerobic activities. Vigorous-intensity activity increases breathing rate and heartbeat more than moderate intensity and makes you sweat. Examples include activities such as running, stairing, and weight lifting.



SUMMARY AND INTRODUCTION

International studies have consistently shown that movement status during the day (physical activity, sedentary behavior, and sleep) are major indicators of health. These behaviors are strongly interrelated; however, several guidelines related to the factors associated with movement focus on each activity separately. Considering these activities in isolation may be insufficient to develop and implement the recommendations needed to achieve optimal physical and mental health. A consolidated approach considers the overall activity over 24-hours, which consists of periods of physical activity, sedentariness, and sleep.

Therefore, having one comprehensive resource is more efficient for improving an individual's health, preventing chronic diseases, and consequently, reducing morbidity and mortality. Many countries, including, Canada, Australia, South Africa, and the World Health Organization (WHO) have introduced the 24-Hour Movement and Sleep Duration Guidelines for the following age groups: the early years (0 to <5 years), children and youth (5–18 years), adults (19 –64 years), and older adults (≥65 years).

According to the Authority of National Statistics, Saudi Arabia has one of the lowest rates of physical activity and the highest rates of sedentary behavior in the world¹. Saudi Arabia did not have national guidelines that account for cultural differences regarding the right amount of physical activity, sedentary behavior, and sleep duration, and this called for the establishment of the 24-Hour Movement Guidelines for Saudis.

The guidelines will help Saudis achieve a balance of movement behaviors and encourage a shift from unhealthy behaviors (e.g., excessive screen time) to healthier behaviors (e.g., adequate age-appropriate sleep duration), resulting in improved overall health, well-being, and quality of life, regardless of age. This will also help Saudis understand what a healthier day looks like by shifting their focus from incorporating physical activity into their waking hours to an understanding of what a healthy 24-hour period consists of. The guidelines will also assist health professionals and policymakers as they work to support Saudis of all ages in reaching their optimal health. Although this document is primarily aimed at able-bodied individuals and/or those with no or low acuity conditions (both impacting physical and mental health and well-being), there will be targeted guidelines developed in the future, adjusted for limitations that would impact full adherence to these guidelines.

These new guidelines aim to provide recommendations for healthy Saudis on physical activity, sedentary behavior, and sleep duration over a 24-hour period for all age groups and reflect international-based practice and national evidence taking into account local customs and practices. These guidelines will be reviewed every five years and updated to reflect the best international and national evidence-based practice.



SCOPE AND PURPOSE OF THE GUIDELINES

Recent statistics and available data show that Saudi Arabia is one of the countries with the lowest levels of physical activity and the highest levels of sedentary behavior, as well as a lack of sufficient sleep^{2,3}. The absence of national guidelines on physical activity, sedentary behavior, and sleep duration that incorporate cultural differences have prompted the development of the Saudi 24-Hour-Movement guidelines. Promoting physical activity has been on the agenda of the Saudi government and other national organizations over the past two decades and is a priority of the Saudi Vision 2030 goals.

In addition, the Quality of Life (QoL) program, one of the main programs of the Saudi Vision 2030, includes the following statement: “The Quality of Life Vision Realization Program improves individuals’ lifestyles by developing an ecosystem to support and create new options that boost citizens’ and residents’ participation in cultural, environmental, and sports activities”. One of the main objectives of the QoL program is to “increase public participation in sports and athletic activities”⁴.

A review by Al-Hazzaa and Al Marzooqi (2018) provided a descriptive analysis of physical activity initiatives for health promotion in Saudi Arabia, and stated that institutions and organizations from several sectors joined efforts to implement ten national initiatives to promote physical activity and sports in the country⁵. Table 1 (Appendix B) demonstrates the sectors involved, including health, education, sports, urban design, environment, transportation, and tourism.

Thus, the Saudi 24-Hour-Movement guidelines will be a milestone for Saudi Arabia’s National Vision 2030 as it helps policy and decision-makers to implement their plans for the public, based on the best practices in this field, especially concerning health-related objectives. Furthermore, the Saudi 24-Hour-Movement guidelines initiative is important for health prevention and promotion to reduce morbidity and mortality among Saudis and residents in Saudi Arabia.

People in Saudi Arabia have become more educated and engaged in various programs and initiatives related to healthy lifestyles. For instance, the percentage of individuals in the Saudi population who engage in 150 min or more per week of moderate-to-vigorous intensity physical activity increased from 13% in 2016 to 22.34% in 2019¹. In addition, more than 50% of the Saudi population (56.05%) engaged in walking for health purposes in 2019⁶. Therefore, the Saudi 24-Hour-Movement guidelines will serve as a framework for professionals (health practitioners, educators, coaches, etc.) that, in turn, can contribute to achieving the objectives of Saudi Vision 2030.



OBJECTIVES OF THE GUIDELINES

01

Provide recommendations on the types and amounts of time in a 24-hour day that Saudi adults, adolescents, and young children should spend being physically active or sleeping to achieve optimal health, as well as the maximum time that should be spent in sedentary activities, based on the best available scientific evidence.

02

Contribute to the achievement of the main objectives of the related programs of Saudi Vision 2030.

03

Bring together various sectors such as the Ministry of Health (MOH), the Ministry of Education, the General Authority of Statistics, and the Ministry of Sports, as well as academics and researchers to adapt the messages and recommendations of the national guideline and contribute to developing future guidelines.

04

Provide recommendations to suit the specific needs and interests of healthcare, education, academic, and sports professionals and the context in which they work.

DISSEMINATION, IMPLEMENTATION, AND AUDIENCE OF THE PRACTICE GUIDELINES

The goal of these practice guidelines is to provide policymakers, healthcare providers, health educators, researchers, sports professionals, and members of the public with recommendations on how much time they should spend engaged in physical activity, sedentary behavior, and sleep. Dissemination of these practice guidelines in an accessible and understandable manner will encourage behavior changes without making end-users feel guilty, and without implying additional equipment or facilities, which is vitally important for the public.



INTRODUCING THE 24-HOUR MOVEMENT PRACTICE GUIDELINES FOR SAUDI ARABIA

BACKGROUND AND RATIONALE

Research has shown the need for regular and adequate physical activity and sleep duration as a means to longer and healthier lives, better health, and prevention of disease⁷⁻⁹. More health professionals are showing a growing interest in studying the interaction of various movement behaviors within a period of 24 hours (e.g., physical activity of all intensities, sedentary behavior, and sleep) to influence overall health¹⁰⁻¹⁵. Three separate guidelines indicate that these behaviors are isolated and independent from each other. Researchers around the world have acknowledged that these behaviors are inter-related, and the time spent in physical activity, sedentary behavior, and sleep should be accounted for. Using robust processes, several countries, including the UK, Canada^{12,16}, Australia¹⁷, South Africa¹⁸, and the WHO¹⁹ have developed 24-hour movement guidelines on how much time children, young adults, and older adults should spend on moderate-to-vigorous physical activity, sedentary behavior, and sleep.

Recently, Saudi Arabia has experienced rapid cultural, political, economic, and developmental changes. In addition, a gradual shift from rural to urban living has been seen in the past three decades²⁰ in the country, which has led to a marked change in the lifestyle and behavioral choices of people, including less physical activity²¹⁻²³. The standard of living of the people has been rising, and mechanization is apparent in all aspects of life. In fact, physical inactivity and associated lower levels of physical fitness have become prevalent in society^{1,24,25}. Moreover, with satellite TV, excessive use of social media, and increased reliance on computers and telecommunication technology, sedentary behavior has increased dramatically, especially among the younger generation¹. In addition, lifestyle changes and new technology such as satellite TV and social media cause a delay in bedtime among Saudis, who have to wake up early for schools or work, resulting in reduced nocturnal sleep duration²⁶⁻³³. The impact of lifestyle changes on societal health is considerable. In fact, these changes are believed to be partly responsible for the epidemic of non-communicable diseases (NCD's) such as coronary heart disease (CHD), type 2 diabetes, obesity and high blood pressure, and the complications associated with these health issues³⁴⁻³⁶. As industrialization and modernization increase, several changes will be seen in the physical activity and eating patterns of people. It is evident that lifestyle changes are dramatic. Recently, sleep deprivation has been declared a "public health epidemic", and a recent paper proposed that insufficient sleep syndrome is a potential NCD³⁷.

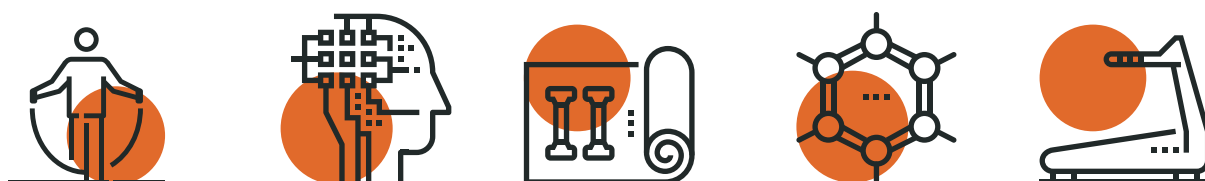


Current international data indicate that insufficient sleep is associated with serious adverse health outcomes. Furthermore, insufficient sleep has been associated with seven of the 15 leading causes of death. Insufficient sleep has been linked to increased mortality and morbidity, such as an increased risk of cardiovascular diseases, obesity, metabolic disorders, type 2 diabetes, reduced immunity, depression, and cancers^{37,38}.

Physical inactivity is higher in certain population samples; for instance, 78% of women and female adolescents in Saudi Arabia have an inactive lifestyle^{21,22}. Although several studies have stressed the importance of increasing physical activity to stop the increase in the number of people diagnosed with NCD's²² in Saudi Arabia³⁹⁻⁴¹, physical inactivity remains a public health concern in the country.

The WHO has expressed concern about the rising rates of NCD's in Saudi Arabia⁴². In response, the Saudi MOH Initiatives and Saudi Vision 2030 have recommended promoting a healthier lifestyle. The prevention of NCD's and their associated risk factors, promoting physical activity, decreasing sedentary behavior, and obtaining sufficient sleep are key elements of healthier lifestyles, which will improve the health of the population and lower health expenditure^{38,42}.

To meet the daily recommended sleep duration and the time spent being physically active, and limit sedentary behavior, the pattern of overall movement activities and sleep duration across a twenty-four-hour period must be carefully identified for all age groups. This time frame includes the time spent being physically active, sitting, or sleeping, which is appropriate for their health and well-being.



PRACTICE GUIDELINES RECOMMENDATIONS

How do we define physical activity, sedentary behavior, and sleep duration?

To understand and apply the guidelines, it is important to be able to interpret and contextualize the meaning of physical activity, sedentary behavior, and sleep duration requirements across the age groups within a 24-hour period.

These can be defined as follows:



Physical Activity

Any body movement produced by skeletal muscles that result in energy expenditure¹



Sedentary Behavior

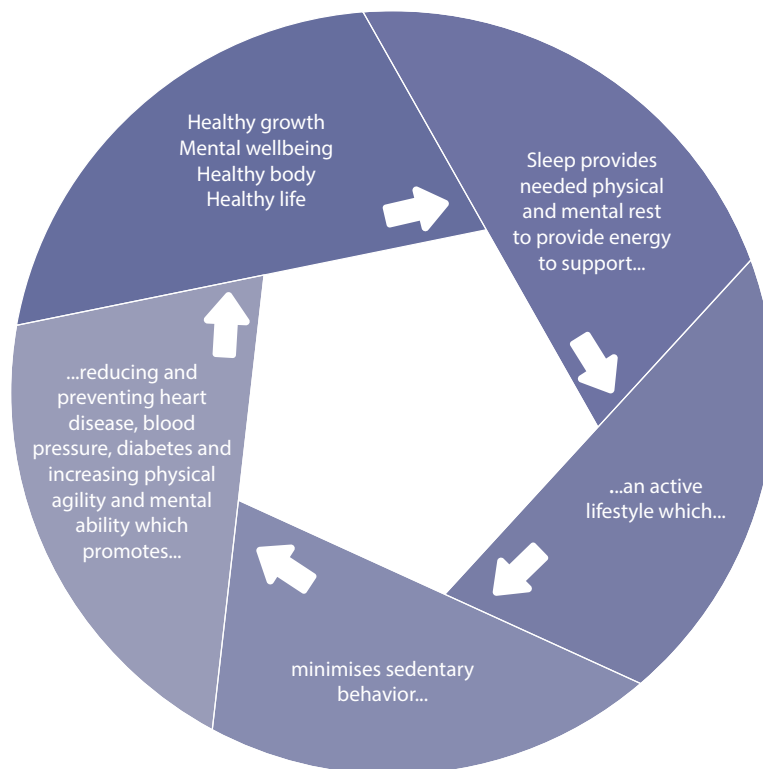
Any waking behavior characterized by an energy expenditure ≤ 1.5 METs, while in a sitting, reclining or lying posture. In general this means that any time a person is sitting or lying down, they are engaging in sedentary behavior²



Sleep Duration

A reversible behavioral state of perceptual disengagement from and unresponsiveness to the environment. Sleep is typically (but not necessarily) accompanied by postural recumbence, behavioral quiescence, closed eyes, and all the other indicators commonly associated with sleeping³

The integrated benefits of these activities can be shown as:



1. World Health Organisation, https://www.who.int/health-topics/physical-activity#tab=tab_1
2. Owen N, Leslie E, Salmon J, Fotheringham MJ. Environmental determinants of physical activity and sedentary behavior. *Exer Sport Sci Rev.* 2000;28(4):153–8. Carskadon, M.A., Dement, W.C. (2011). Monitoring and staging human sleep. In Kryger, M.H., Roth, T., Dement, W.C. (Eds.), *Principles and practice of sleep medicine*, 5th edition, p16–26. St. Louis: Elsevier Saunders.



THE EVIDENCE

Physical activity is an important goal of health promotion because improvements in health are related to physical activity⁴³. Engaging in regular physical activity has been proven to have physiological and psychological benefits for an individual's overall health. Physiologically, people who exercise regularly may reduce the risk of several chronic diseases such as heart diseases, stroke, diabetes, hypertension, and cancers. Moreover, participating in regular physical activity plays an essential role in maintaining energy balance, bone mass, and weight control^{40,42,44-47}. Being physically active contributes to psychological well-being; people who exercise regularly tend to feel less anxious, depressed, or stressed⁴⁸. They also tend to have a positive mood, increased alertness and energy, and are more likely to work actively. In addition, they have a positive self-concept, body image, self-esteem, achievement attitude, and cognitive function^{49,50}. Furthermore, physical activity seems to decrease the risk of engaging in negative health behaviors, such as smoking⁵⁰.

Physical activity is reported to decrease cardiovascular risks, improve the lipid profile, control type 2 diabetes, prevent the incidence of some types of cancers, increase bone density, improve psychological health, cognitive function, and well-being, and reduce mortality^{21,23,51}. In addition, regular physical activity may decrease inflammatory responses throughout the body. It has been established that inflammation can increase the risk of heart diseases, accelerate aging and depression, and lead to major neurocognitive disorders²³. Physical activity can also improve brain health, neuroplasticity, and cognitive function^{21,22,39}. Moreover, physical activity may improve learning and cognitive function in children⁴⁰.

It has been suggested that Saudi children and adolescents should be physically active to meet international recommendations⁵². The Arab Teens Lifestyle Study indicated that boys were more active than girls with approximately 56% and 22% average prevalence of moderate physical activity, respectively^{1,53}. A high rate of sedentary behavior was observed in adolescents; for instance, 84% of men and 91.2% of women reported more than two hours of daily screen time²⁵. A high rate of physical inactivity and sedentary behavior among Saudi adolescents is an alarming indication of future health concerns, such as coronary heart disease (CHD) and obesity^{54,55}. Findings in the Coronary Artery Disease in Saudi Arabia reinforce the positive impact of physical activity in reducing obesity. The findings also indicate that active men and women (30- 70 years old who engage in 30 min of moderate-intensity activity three or more times per week) have lower BMI and waist circumference than those who are inactive⁵⁶.



In contrast, **sedentary behavior** is a major factor that leads to NCD's and total mortality^{21,23,51}. It is estimated that sedentary behavior is globally responsible for 9% of premature mortality, or more than 5.3 million deaths annually⁵⁷. According to the WHO's global statistics, one in four adults is not active enough, and more than 80 percent of the world's adolescent population is not sufficiently physically active^{51,58}. The WHO Global Action Plan for the Prevention and Control of NCD's has set a target for member states to achieve a 10% reduction in physical inactivity by 2025⁵⁹. A growing body of literature has identified sedentary behavior as a factor associated with at least 35 diseases⁶⁰.

Several studies have linked sedentary behavior to cardiometabolic biomarkers such as increased waist circumference, triacylglycerol, HbA1c, and systolic blood pressure, and decreased HDL cholesterol. Sedentary behavior is also associated with an increased risk of metabolic syndrome and diabetes^{13,61-66}. A meta-analysis found evidence of a significant positive association between sedentary behavior and the risk of type 2 diabetes and strong evidence of a significant association between sedentary behavior and all-cause mortality⁶⁷.

Insufficient **sleep** or irregular sleep patterns have been linked to increased morbidity and mortality⁶⁸⁻⁷¹. For instance, sleep deprivation or short sleep duration was associated with a greater risk of developing heart diseases⁷²⁻⁷⁴, stroke⁷⁵, type 2 diabetes^{76,77}, hyperlipidemia^{78,79}, high blood pressure^{80,81}, cancer^{82,83}, systemic inflammation⁸⁴, and obesity⁸⁵⁻⁹⁰. An insufficient amount of sleep can lead to dangerous health outcomes that may affect almost all organs and systems. Insufficient sleep has also been linked to cognitive impairment, poor academic performance, obesity, hypertension, insulin resistance, and diabetes, in addition to other health problems³⁷. The body's immune system is weakened by inadequate sleep, in addition to an increase in systemic inflammation, inflammatory markers, and the occurrence of hormonal disturbances. Evidence suggests that insufficient sleep alters gene expression in human blood cells and decreases the amplitude of circadian rhythms in gene expression. Furthermore, a shorter duration of sleep is associated with increased mortality, increased risk of motor vehicle and industrial accidents, and deteriorating job performance. The harmful effects of insufficient sleep go beyond the individual to the community, as it has been shown to result in substantial economic costs, with undesirable effects on economic output and labor productivity³⁷.

The quality and duration of sleep affect mortality, health, and memory. Sleep affects both types of memory in adults: procedural memory, such as remembering skills and procedures; and affirmative memory, such as recalling facts⁹¹. Obtaining enough sleep at night is essential for maintaining health and normal body system functions; however, what is considered "sufficient sleep" varies from one person to another. The National Sleep Foundation recommends sleeping 8- 10 hours for adolescents, 7- 9 hours for young adults and adults, and 7- 8 hours for older adults^{92,93}.



GOALS

The recommendations are based on the integrated needs of each age group. Users of the guidelines would need to adjust the recommendations for mixed ability groups such as disadvantaged individuals, those with preexisting conditions, or those undergoing treatment affecting the ability to undertake the recommendations. It is recommended that a model that supports a gradual increase in activities and improved sleep be adopted to achieve optimal recommendations.

The goals that we wish to achieve are:

Early Years

Infants (less than 2 years)

- Optimal learning and cognitive development.
- Normal growth targets being achieved.
- Improved hand-eye co-ordination.
- Reduced tendency for future lifestyle diseases.
- Best start to develop lifelong healthy habits.

Toddlers (3 - 5 years old)

- Optimal learning and cognitive functioning.
- Achieving normal growth targets.
- Improved hand-eye co-ordination.
- Reduced tendency for future lifestyle diseases.
- Development of lifelong healthy habits.

Children and adolescents

(6 - 17 years old)

- Educational attainment.
- Mental wellbeing.
- Feeling energized.
- Improved fitness .
- Achieving and maintaining healthy body weight.
- Opportunities to learn new physical skills .
- Social interaction and skills.
- Maintaining lifelong healthy habits.

Adults

(18 - 64 years old)

- Educational attainment.
- Potential for better employment, career goals and productivity.
- Mental wellbeing.
- Providing the best chance of a reduction in developing avoidable diseases.
- Improved fitness.
- Improved bone and muscle strength.
- Achieving and maintaining healthy body weight.
- Greater opportunities for social and Community interactions and engagement.

Older adults

(≥65 years old)

- Optimal cognitive function.
- Mental wellbeing.
- Keeping active and agile.
- Maintaining independence.
- Health maintenance.
- Greater opportunities for social connections.



RECOMMENDATIONS



Infants (less than 1 year old)



Physical Activity

- Infants should be physically active several times daily in a variety of ways, including supervised interactive floor-based activity; the more the activities, the better.
- For infants not yet mobile, a minimum of 30 min of tummy time spread throughout the day while awake (and other movements such as reaching and grabbing, pushing and pulling themselves independently, or rolling over); the more the activities, the better (conditional).
- Examples include rolling, crawling, tummy time, reaching or grabbing for objects, toys, pushing, and pulling themselves independently.



Sedentary Behavior

- Not restrained during waking hours for more than 1 h at a time (e.g. in a stroller, car seat or high chair).
- Be encouraged to engage in activities such as reading and storytelling with a caregiver when sedentary.
- Screen time is not recommended.



Sleep Duration

Newborns (0–3 months)

- For optimal health, in newborns (0–3 months), 14 to 17 h of good quality sleep per 24 h (for the first 28 days, newborns may sleep for up to 20 h) is recommended (including daytime sleep) (strong).

Infants (4–11 months)

- For optimal health, in infants (4–11 months), 12–16 h of good quality sleep per 24 h is recommended (including daytime sleep) (strong).



RECOMMENDATIONS



Toddlers (1–2 years old)



Physical Activity

- Toddlers should spend a minimum of 3 h (180 min) per day in a variety of physical activities at any intensity, including energetic and outdoor play spread throughout the day; the more the activities the better (conditional).
- Examples: walking, running, climbing, pulling, pushing, ball games, activities in the park (riding a tricycle or bike), water activities, and tagging play.



Sedentary Behavior

- Not restrained for more than 1 h at a time (in a stroller, car seat, or high chair) or sitting for extended periods.
- Be encouraged to engage in activities such as reading and storytelling with a caregiver when sedentary.
- For toddlers (1–2 years), sedentary screen time is not recommended.
- For toddlers (2–3 years), sedentary screen time should be no more than 1 h throughout the day; the shorter the time, the better.



Sleep Duration

- For optimal health, in children (1–2 years), 11–14 h of good quality sleep per 24 h is recommended (including naps) (strong).



RECOMMENDATIONS



Pre-schoolers (3–5 years old)



Physical Activity

- Preschoolers should spend a minimum of 3 h (180 min) daily in a variety of physical activities, with a minimum of 1 h (60 min) of energetic and outdoor play, spread throughout the day (conditional).
- They should accumulate 1 h (60 min) or more of moderate-to-vigorous aerobic physical activity per day, which is appropriate for their ages (conditional).
- Examples: Playing organized and free games, running, climbing, pulling, pushing, ball games, activities in the park (riding a tricycle or bike), water activities, and tagging play.



Sedentary Behavior

- Not restrained for more than 1 h at a time (in a stroller, car seat, or high chair).
- Be encouraged to engage in activities such as reading, storytelling, or coloring with a caregiver when sedentary.
- Sedentary screen time should be no more than 1 h throughout the day; the shorter the time, the better.



Sleep Duration

- For optimal health, in children (3–5 years), 10–13 h of good quality sleep per 24 h is recommended (which may include naps), with consistent bedtimes and wake-up times (strong).



RECOMMENDATIONS



Children and adolescents (6–17 years old)



Physical Activity

- Children and adolescents (6–17 years) should engage in a minimum of 1 h (60 min) of moderate-to-vigorous physical activity per day, with most duration as aerobic physical activity (strong).
- They should engage in vigorous physical activity, including muscle and bone-strengthening physical activity, a minimum of 3 days per week as part of their 1 h (60 min) or more per day (strong).
- They should perform several hours of a variety of light physical activities per day (conditional).
- Examples: moderate activity such as brisk walking, housework, recreational swimming, and free physical play.
- Vigorous activity such as running and playing games (football, volleyball, tennis).



Sedentary Behavior

- Limit sedentary recreational screen time to no more than 2 h throughout the day.
- Break-up long periods of sitting as often as possible.



Sleep Duration

Children (6–12 years)

- For optimal health, in children (6–12 years), 9–12 h of good sleep per 24 h is recommended, with consistent bedtimes and wake-up times (strong).

Adolescents (13–17 years)

- For optimal health, in adolescents (13–18 years), 8–10 h of good sleep per 24 h is recommended, with consistent bedtimes and wake-up times.

Daytime nap

- For optimal health, school-aged children (≥ 6 years), and adolescents should get all the recommended sleep during night time (conditional).



IMPORTANT CONSIDERATIONS FOR SLEEP DURATION IN CHILDREN:



A few important considerations need to be explained to complement the recommendations for sleep duration in children:

- Sleeping for the recommended duration with consistent bedtimes and wake-up times is associated with better health outcomes, including improved attention, behavior, learning, memory, emotional regulation, quality of life, and mental and physical health.
- Sleeping less than the recommended duration on a regular basis is associated with attention, behavior, and learning difficulties.
- Insufficient sleep enhances the risk of accidents, injuries, hypertension, obesity, diabetes, and depression.
- Insufficient sleep in adolescents is linked to an increased risk of self-harm, suicidal thoughts, and suicide attempts.
- Sleeping more than the recommended duration on a regular basis may be associated with harmful health outcomes such as hypertension, diabetes, obesity, and mental health problems.
- Parents who are worried about the quality of sleep, sleep duration, or sleep pattern of their child should consult their family physician or pediatrician.



RECOMMENDATIONS



Adults (18–64 years old)



Physical Activity

- Adults should perform a minimum of 2 h and 30 min (150 min) to 5 h (300 min) per week of moderate-intensity physical activity, or 1 h and 15 min (75 min) to 2 h and 30 min (150 min) per week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate and vigorous-intensity aerobic physical activity. Preferably, aerobic activity should be spread throughout the week (strong).
- For more substantial muscle and bone health, adults should engage in strengthening activities using major muscle groups for a minimum of 2 days per week (strong).
- For good physical and mental health, adults should engage in light physical activity and sit less throughout the day (strong).
- Examples include moderate activity such as brisk walking, gardening, recreational swimming, and free physical play. Vigorous activities including jogging, running, playing games (football, volleyball, tennis).



Sedentary Behavior

- Reduce the amount of time spent in prolonged sitting throughout the day.
- Break-up long periods of sitting as often as possible with a minimum of light physical activity.



Sleep Duration

- For optimal health, in adults, ≥ 7 h of good sleep per night is recommended, with consistent bedtimes and wake-up times (strong).
- For optimal health, in young adults (18–25 years), 7–9 h of good sleep per night is recommended, with consistent bedtimes and wake-up time.
- For optimal health, in adults (26–64 years), 7–9 h of good sleep per night is recommended, with consistent bedtimes and wake-up times.



IMPORTANT CONSIDERATIONS FOR SLEEP DURATION IN ADULTS:



A few important considerations need to be explained to complement the recommendations for sleep duration in adults:

- Regularly sleeping for less than 7 h per night is associated with harmful health outcomes, including weight gain and obesity, diabetes, hypertension, heart disease, stroke, depression, and increased risk of death.
- Sleeping for less than 7 h per night is also associated with impaired immune function, increased pain, impaired performance, increased errors, and a greater risk of accidents.
- Sleeping for less than 7 h per night but getting a long daytime nap (splitting sleep between day and night “Bi-phasic sleep”) to maintain the same sleep duration may mitigate the short-term harmful effects associated with shorter nocturnal sleep. The long-term effects of this practice are unknown.
- Regularly sleeping more than 9 h per night may be acceptable for young adults, individuals recovering from sleep debt, and individuals with illnesses. For others, longer sleep duration may be associated with undesirable health effects.
- Individuals who are worried about their quality of sleep, sleep duration, or sleep pattern should consult their physician (healthcare provider).



RECOMMENDATIONS



Older adults (≥ 65 years old)



Physical Activity

- Healthy older adults (≥ 65 years) should engage in a minimum of 2 h and 30 min (150 min) of moderate-intensity per week, or 1 h and 15 min (75 min) of vigorous-intensity aerobic activity per week, or an equivalent combination of moderate to vigorous aerobic physical activity, spread throughout the week (strong).
- If they cannot meet the recommended physical activity, then light activity brings some health benefits, while more daily physical activity provides greater health (strong).
- The recommended physical activity can split in bouts throughout the day (strong).
- Older adults should maintain or even improve muscle strength, balance, and flexibility on a minimum of 2 days per week. These could be combined with sessions involving moderate aerobic activity or additional sessions on separate days (strong).
- Older adults with chronic conditions should consult their doctors or health professionals before engaging in the recommended physical activity (strong).
- Older adults who continue to enjoy a lifetime of vigorous physical activity should carry on doing so while considering safety practices (strong).
- Examples: light activity such as slow walking, housework, gardening, and shopping, moderate activities such as brisk walking, gardening, recreational swimming, tiding housing , and vigorous activities such as jogging, running, and stepping.



Sedentary Behavior

- Reduce the amount of time spent in prolonged sitting throughout the day.
- Break-up long periods of sitting as often as possible with at least light physical activity, when physically possible, or standing.



Sleep Duration

- For optimal health, 7–8 h per night is recommended, with consistent bedtimes and wake-up times.



SPECIAL CONSIDERATIONS FOR SLEEP DURATION IN THE SAUDI CULTURE



Daytime naps

- In adults, daytime napping can be practiced (if feasible); nevertheless, for optimal health, it is recommended that napping time should be around mid-day (noontime) in those who wake up at dawn or early in the morning (conditional).
- In adults, it is recommended to limit daytime nap duration to <30 min.



Dawn prayer and sleep

Practicing nocturnal splitting of sleep due to the Fajr (dawn) prayer showed no evidence of harmful health effects (conditional).



Ramadan and sleep

For optimal health, during Ramadan month, it is suggested that sufficient sleep at night (4–6 h) needs to be supplemented with daytime sleep of 1.5 – 2 h. To avoid disturbing the circadian rhythm and sleep, it is also recommended to limit food intake to two main meals at night (+ a snack if needed): one around sunset and the other in the pre-dawn time (conditional).



AREAS FOR FUTURE RESEARCH



Physical activity

The Physical Activity Guidelines Development Panel identified a number of research gaps in the development of the reviewed guidelines. In Saudi Arabia, physical activity guidelines need to be developed based on Saudi population cohort studies with good methodology in healthy individuals, and people with different conditions (cardiovascular disease, diabetes, metabolic syndrome, obesity, and cancer) to establish the prevalence of national physical activity and identify risk factors associated with physical inactivity. Researchers around the country need to establish accurate and reliable assessment tools for physical activity to provide more precise data comparison and inferences between studies. Furthermore, cultural context studies of physical activity are needed, as there are gaps in this field that need to be filled with clear comprehensive answers.

Areas for more high-quality studies include -but are not limited to- the following:

- Identify the recent physical activity trends in Saudi Arabia, especially during the recent evolution of Saudi Vision 2030.
- Apply the most recently recommended methodology for assessing physical activity, including the use of objective measurements.
- Examine the health benefits of physical activity components (types, intensity, duration, and weekly frequency) for each age group.
- Assess physical activity level, where possible, in all Saudi regions.
- Develop the key factors that enable dissemination, adaptation, activation, implementation, and uptake of physical activity guidelines.





Sedentary behavior

The guidelines development panel identified a number of research gaps during the development of these guidelines.

The areas for high-quality studies include the following:

- Establish standardized procedures and objective measurements of sedentary behavior to enable comparison between studies.
- Use direct objective measures of sitting (i.e., thigh-mounted activity monitors).
- Compare the health impact of passive vs. active sedentary behavior.
- Investigate the effect of sedentary behavior on health in different populations (i.e., pregnant women, after childbirth, people with cardiovascular diseases, people with neurological disease, etc.).
- Establish the cost-effectiveness of sedentary behavior-targeted interventions.
- Examine the key factors that enable dissemination, adaptation, activation, implementation, and uptake of guidelines.



Sleep duration

The panel indicated the following areas that need more research:

- Patterns of napping in children in Saudi culture and their long-term health effects.
- Assess the best time for daytime napping and its relation to the bedtime and rise time of the individuals.
- Long-term effects of splitting the total sleep duration per 24 h between day and night.
- Further studies on the effects of splitting sleep due to Fajr prayer on neurobehavioral performance, cognitive function, and long-term health outcomes are needed.
- Determine the optimal sleep pattern during Ramadan, which promotes good health outcomes.



THE DEVELOPMENT OF THE PRACTICE GUIDELINES

These guidelines were developed in February 2020 with the formation of a national committee appointed by the Public Health Authority. The committee comprised seven guidelines panel members of various specialties (physical activity specialists, epidemiologists, nutrition and diet specialists, sleep medicine, and guideline-development methodologists). The committee was supported by a few sub-committees (core panel), where there were shortages in individual specialty areas.

The practice guideline development process involved two interdependent groups: a core panel and an expert panel. The core panel guided the expert panel through the voting process (RAND appropriateness method) and provided formulated recommendations to the expert panel. The expert panel used the data and evidence provided by the core panel to arrive at a consensus.

The committee defined preliminary questions for its duties:

Question 1: What is the dose (i.e., duration, frequency, intensity, and type) of physical activity, as measured by objective and subjective methods, needed for optimal health?

Question 2: What is the dose (i.e., duration, pattern [frequency, interruptions], and type) of sedentary behavior, as measured by objective and subjective methods needed for optimal health?

Question 3: What is the sleep duration needed for optimal health?

Groups and roles

The National Committee was responsible for supervising the development of each guideline, communicating with guideline panels, conducting literature searches, updating systematic reviews, and chairing guideline panel meetings.

The Public Health Authority was also responsible for communication, logistics, and final agreements on guideline topics. A coordinating committee was involved in determining the scope of the investigation, appointing specialists and expert panel members as needed, creating a program for the adaptation process, and assigning responsibilities.

The guideline core panel members were involved in the prioritization of questions related to the guideline's topics:

Physical activity: formulation of recommendations of physical activity for healthy children, adolescents, adults, and older adults during panel meetings, and drafting a guideline manuscript for peer-reviewed publication. A summary of the guideline development process is described through online presentations.

Sedentary behavior: formulation of recommendations of sedentary behavior dose and interruptions on healthy children, adolescents, adults, and older adults during panel meetings, and drafting a guideline manuscript for peer-reviewed publication. A summary of the guideline development process is described through online presentations.



Sleep duration: formulation of recommendations of sleep duration on healthy children, adolescents, and adults during panel meetings, and drafting a guideline manuscript for peer-reviewed publication. In addition, the panel members formulated recommendations for unique cultural and religious factors that may affect nighttime sleep duration, such as prayer times, daytime napping, and Ramadan month. A summary of the guideline development process is described through online presentations.

Identification of the necessary facilities and skills

An “expert panel” was constituted for each topic (physical activity, sedentary behavior, and sleep duration). Specialists and experts in the selected fields were identified and allocated to each subcommittee to help the panel function effectively. Time commitment by panel members of each subcommittee, membership rules, and terms of collaboration were determined. All panel members of the sub-committees declared that they did not have any competing interests. The Public Health Authority organizing committee clarified the decision-making process, how decisions would be managed, and how the drafts guidelines would be written, and by whom. All specialists and experts declared no conflicts of interest.

Writing the adaptation plan

The adaptation plan guidelines were written, and the adaptation process, together with the target headings, was determined. The target headings included the introduction, the subject area, the names and credentials of the panel members of each committee, declarations on competing interest, panel terms of reference, and completion timeline and meeting schedule (Figure 1, Appendix C). Decisions reached by the Public Health Authority coordinating committee were transparently documented and conveyed to the panel members of the sub-committees via email, letters, and telephone calls.

Determining and prioritizing questions for selected guidelines

For each selected guideline, a formal process was used to prioritize the significant questions. The selected questions were sent to panelists for approval, with the opportunity for further input before finalization. The questions prioritized by the panel members for each topic were as follows:

- What is the physical activity dose (in terms of frequency, intensity, duration, and type) needed for optimal health in healthy people of different age groups?
- In people of different age groups, what dose (i.e., duration, pattern [frequency, interruptions], and type) of sedentary behavior, as measured by objective and subjective methods, is associated with favorable health indicators?
- What is the sleep duration needed for optimal health in healthy subjects of different age groups?

For the sleep duration guidelines, the panel focused only on the sleep duration component, while understanding the importance of other factors that affect sleep and health, such as timing, regularity, and quality. However, for the sake of this practice guideline, sleep duration was the only assessed factor. In addition, the panel explored local factors imbedded in the Saudi culture that may affect sleep duration, that is, prayer times, daytime napping, and Ramadan month.



Searching guidelines and other relevant evidence

A systematic search was performed by researchers to find all pertinent articles and practice guidelines published from January 2010 to April 2020, and present the results to panel members. The search strategy applied in this guideline used the following keywords for each topic:

- Physical activity: “physical activity”; “physical activity guidelines”; “movement guidelines”; “chronic diseases”; “review”; “systematic review”; “meta-analysis”; “randomized controlled trial”; “cardiovascular disease”; “cancer”; “hypertension”; “diabetes”; cognitive function”; academic performance”; “metabolic syndrome”; “obesity”; “mortality”; “metal health”; “psychiatric health”; “immunity”; “inflammation.”
- Sedentary behavior: “sedentary”; “guidelines”; “meta-analysis.”
- Sleep duration: “sleep duration”; “guidelines”; meta-analysis”; “Randomized controlled trial”; “cardiovascular disease”; “cancer”; “hypertension”; “diabetes”; cognitive function”; “memory”; academic performance”; “metabolic syndrome”; “obesity”; “pain”; “mortality”; “metal health”; “psychiatric health”; “immunity”; “inflammation”; “job performance.”

Screening of retrieved evidence-based practice guidelines

Due to time constraints, the panel agreed to limit the selected practice guidelines (PG’s) to the best, most recent, and updated available guidelines that addressed the significant questions. Screened guidelines were evaluated using the Appraisal of Guidelines for Research & Evaluation II (AGREE II) instrument, and PGs that addressed the questions and attained the highest quality scores based on this instrument were chosen for the adaptation process. Moreover, updates to each of the selected PG’s were performed by reviewing systematic reviews, longitudinal studies, and RST’s published after the adopted PG’s.

Eligibility criteria

The core panel decided to include structured PG’s based on a systematic review of related research evidence. The information about the evidence-based method used in the PG’s was obtained from the methods section and search strategy reported in the guidelines and grading of the strength of evidence.

Opinion articles, reviews of the literature, systematic and narrative reviews, protocols, clinical pathways, physician guide booklets, patient guides, and editorials were not included in this step.

Selected practice guidelines

The development process was directed by the “GRADE-ADOLPMENT” approach, which combines the advantages of adaptation, adoption, and de novo guideline development (Figure 2)⁹⁴. A core panel (sub-committee) was formed for each topic, and credible guidelines were identified.



Physical activity

Physical activity guidelines published by different countries such as the US, UK, Canada, Australia, New Zealand, South Africa, and Singapore, and leading organizations such as the WHO and the European Union were searched and explored by physical activity panel members^{12,16,18,19,51,95–102}. Five of these guidelines, including those published by the US, UK, Canada, Australia, and WHO were found to be the most recent and updated, based on robust evidence using a more developed methodology^{12,16,19,51,96,98,100–102}. The most recent US physical activity guidelines were updated in 2018 and included age groups from 3 years to older adults¹⁰⁰. In 2019, the UK also developed its own physical activity guidelines (UK Chief Medical Officers' Physical Activity Guidelines) for all age groups, including children under 5 years old⁹⁷. Canadian and Australian physical activity guidelines were part of the 24 h movement guidelines for all age groups, from newborns to older adults^{12,16,17}. The WHO published the Global Recommendations on Physical Activity for Health for age groups of 5 years and above⁵¹. Also, the WHO issued "Guidelines on Physical Activity, Sedentary Behavior and Sleep for Children Under 5 Years of Age"¹⁹. Saudi physical activity guidelines were developed by adapting the most recent and suitable guidelines for Saudi Arabia in all apparently healthy age groups. Moreover, evidence from national literature, including systematic reviews, RST's, and the most recent available reports from the General Authority of Statistics, was reviewed by the physical activity consensus panel. The selected guidelines and evidence were appraised by three independent reviewers based on the AGREE II instrument. The scores for each guideline were then aggregated, and the highest-scoring guidelines in each age group were selected for guideline adaptation. In addition, the culture of the Saudi population, including religion and lifestyle, has been considered in adapting the selected physical activity recommendations.

Sedentary behavior

Seven guidelines were identified for the preparation of adaptation. These guidelines include the following: one standalone sedentary behavior guideline (WHO Guidelines on Physical Activity, Sedentary Behavior, and Sleep for Children Less Than 5 Years of Age)¹⁰³, two physical activity guidelines with recommendations for sedentary behavior embedded within (UK Chief Medical Officers' Physical Activity Guidelines, and Australia's Physical Activity and Sedentary Behavior Guidelines [for Adults 18–64 years)¹⁰⁴, and four 24 h movement guidelines: Canadian 24-Hour Movement Guidelines for Children and Youth, Canadian 24-Hour Movement Guidelines for the Early Years (0–4 years)¹⁶, Australian 24-Hour Movement Guidelines for the Early Years (Birth to 5 years)¹⁷, and Australian 24-Hour Movement Guidelines for Children (5–12 years) and Young People (13–17 years)¹⁰⁵. These guidelines were appraised by four independent reviewers, based on the AGREE II instrument. Then, the scores for each guideline were aggregated, and the highest scoring guidelines in each age group were selected for guideline adaptation.



Sleep duration

GRADE Recommendation System

Although the level of confidence in the recommendation is a continuum, the GRADE system describes two levels of evidence: strong and conditional.

Strong Recommendation: is defined as the recommendation when the panel is confident that the desirable effects of adherence to the recommendation outweigh the undesirable effects.

Conditional Recommendation: is defined as the recommendation when the panel infers that the desirable effects of adherence to the recommendation outweigh the undesirable effects, but the panel is not confident about this trade-off.

When the recommendation was conditional, that was indicated in brackets after the recommendation.

The draft “Recommended amount of sleep for healthy adult and pediatric populations: a joint consensus statement of the American Academy of Sleep Medicine (AASM) and Sleep Research Society (SRS) and National Sleep Foundations (NSF)” best fit the criteria approved by the panel^{68,106,107}. These were appraised based on the evidence in the GRADE tables, summary of the findings tables, and draft recommendations from the AASM/SRS and NSF Draft Guidelines⁹⁴. Updates to each of the AASM/SRS and NSF systematic reviews were conducted by reviewing systematic reviews, longitudinal studies, and RCT’s published after January 2016. The Consensus Panel reviewed the evidence and made a decision to adopt or adapt the AASM, SRS and NSF recommendations for sleep duration, or create de novo recommendations.

We adopted the AASM/SRS and NSF development process, which was guided by the adapted “RAND Appropriateness Method” (RAM) to determine the amount of sleep required to enhance the best health outcomes in children, adolescents, adults, and older adults in Saudi Arabia¹⁰⁸. The RAM method is based on a structured review of the scientific literature and the collective judgment of an expert panel using the Delphi methodology¹⁰⁸.

Justifications for incorporating AASM/SRS and NSF

In the research in adopting and adapting the US guidelines for sleep duration, two American guidelines were used, including the AASM/SRS and the NSF. The two guidelines were used because the AASM/SRS did not cover all the targeted age groups. Therefore, to discuss sleep duration in all age groups (including neonates and older adults ≥ 65 years), the NSF was also used. It is also essential to incorporate the two guidelines to ensure trustworthiness in the adoption and adaptation processes.



Preparing the draft of the adopted guidelines

A qualitative exploratory; descriptive study was conducted to integrate cultural factors and local customs based on the available data. In addition, the chosen guidelines were not the only sources used. Specifically, when needed, recommendations were also obtained from other scientific sources such as RCT's; and non-selected guidelines to develop a thorough guideline that accounts for new updates and cultural factors.

Each sub-committee of experts (core panel) worked independently and performed an extensive review and analysis of the literature. The expository drafts of the proposed guidelines in each field were then developed. The members of the organizing committee met to clarify ambiguous and incomprehensible phrases, remove redundant sentences, and ensure the overall coherence of the practice guidelines. The organizing committee also approved the drafts before submitting the guidelines to experts (expert panel). The panel considered the traditions and culture of Saudi Arabia.

Expert panel selection

The main selection criteria to be considered for experts (expert-panelists) were acknowledged leadership in the panel member's specialty, absence of conflicts of interest, regional diversity (of the Kingdom, when feasible), and diversity of practice setting (academic vs. practicing). The experts were not chosen because they were easily accessible or friendly¹⁰⁸. The panel of experts permitted sufficient diversity while ensuring that all had a chance to participate¹⁰⁸. This, of course, depended on the availability of specialists in each of the three specialties addressed.

Physical activity and sedentary behavior

Following the AGREE II and "GRADE-ADOLOPMENT" approach of guideline recommendations, the physical activity and sedentary behavior panels were made up of three and four members, respectively. The panelists included specialists from three leading institutions; in Saudi Arabia: King Saud University, Princess Nourah bint Abdulrahman University, and Umm al Qura University. The panel members completed a conflict of interest disclosure and were instructed not to work with organizations were practicing similar activities.

Sleep duration

Following the RAM recommendations, the Sleep Duration Consensus Conference panel (expert panel) was made up of practicing Saudi physicians practicing sleep medicine or related specialties. The panelists included representatives in sleep medicine and related specialties (family medicine, psychiatry, child development, and behavioral sleep medicine) and clinical specialists from the leading institutions in the Kingdom of Saudi Arabia, the Saudi Sleep Medicine Group, and a research methodology expert. The panel members filled a conflict of interest disclosure and were instructed not to work with organizations that were practicing similar activities.



The Modified RAM

A consensus on the formulated recommendation was reached using the RAM, where experts used current scientific evidence in conjunction with expert opinion to reach an agreement.

The RAM uses crucial scientific literature, together with two turns of voting (the first round was anonymous) to establish agreement on the suitability of approval. In round 1, the expert panel members received the recommendation via an online link and were asked to rate the appropriateness (on a 1–5 Likert scale) of each recommendation. They did not interact to ensure that there was no interference from votes. They were allowed to use the synthesized evidence provided by the core panel, overseeing the consensus process. An expert (participant) information sheet was sent to the participants in the expert panel on each topic (specialty) to give a brief overview of the project to all selected experts who agreed to participate in both voting rounds (Appendix D).

Ethics committee approval was obtained before starting the first round of the RAM study. Members of the core panel reviewed the results of round 1 voting and the available evidence before round 2 voting was conducted.

Round 2 voting aimed to give the expert panel members the chance to discuss their ratings face to face over one day, considering their knowledge of how all the other experts rated (Appendix E below for round 1 and Appendix F for round 2 questionnaires). Round 2 voting was conducted via a zoom meeting and was led by an experienced moderator in each discussed topic. The moderator of the meeting focused on recommendations where there was significant disagreement in the experts' ratings to find out if there was genuine clinical disagreement about the appropriateness or if there was a problem with the rating structure¹⁰⁸.

The process of voting rounds

The Consensus Conference included two rounds of voting as a way of modifying the RAM¹⁰⁸. After the first round, expert panel members were provided with feedback to refine their answers. The iteration process was used to guarantee the credibility. Voting in the second round led to the establishment of final consensus recommendations.

Data analysis for rounds 1 and 2

Answers were aggregated, and frequencies and percentages were calculated for the answers using the online questionnaire itself before the data were tabulated with qualitative responses as feedback for round 2.

Each indication was classified as “appropriate,” “uncertain,” or “inappropriate” for the procedure under review in accordance with the experts' median score and the level of disagreement among the experts. Indications with median score in the 1–2 range were classified as inappropriate, 3 as uncertain, and in the 4–5 range as appropriate. Each statement that achieved 80% or higher from the summation of scores 4 and 5 on the Likert scale was considered an agreement. Consensus was defined as an agreement of 80% or higher.



Details of the rounds

Round 1

Before the conference, the two guidelines that were reviewed by the core panel members were accepted. The core panel members agreed on the following statement based on their expertise: “Based on the available evidence, there is a relationship between specified sleep hours and best health within specified health categories in specified age groups. Sleep hours were classified as 7–17 h. A 5–point Likert scale was used where 1 represented “strongly disagree,” 5 represented “strongly agree,” and 3 represented “neither disagree nor agree.” to ensure independence, members of the expert panel were advised not to share evidence, and the collection of votes from round 1 was done anonymously. The votes were then compiled to determine the distribution of votes.

For physical activity and in people older than 17 years, the panel used all health outcomes and subcategories adopted by the UK Chief Medical Officers’ Physical Activity Guidelines to determine the relationship between sedentary behavior and health outcomes. In rounds 1 and 2 voting was based on evidence supporting these health outcomes. These outcomes are general health, cardiovascular health, metabolic health, diabetes, obesity, mental health, human performance, cognitive performance, cancer, pain, and mortality. The following age groups were considered: Infant, <1 year old; Toddler, 1–2 years old; preschooler: 3–5 years old; children and young people, 5–17 years old; adult, 18–64 years old; and older adult, ≥65 years old.

For sedentary behavior, the organizing committee adopted the Australian 24-Hour Movement Guidelines for the Early Years (Birth to 5 years), Australian 24-Hour Movement Guidelines for Children (5–12 years) and Young People (13–17 years), and UK Chief Medical Officers’ Physical Activity Guidelines, as these guidelines met the criteria set by the panel. Updates to the systematic reviews of each of these guidelines were conducted by reviewing systematic reviews published after March 2017 for the Australian 24-Hour Movement Guidelines for the Early Years (Birth to 5 years) and Australian 24-Hour Movement Guidelines for Children (5–12 years) and Young People (13–17 years). Furthermore, to update the UK Chief Medical Officers’ Physical Activity Guidelines, systematic reviews published after January 2019 were reviewed.



For people younger than 17 years, the panel used the eight health indicators adopted by the Australian 24-Hour Movement Guidelines to determine the relationship between sedentary behavior and health outcomes. In rounds 1 and 2, voting was based on evidence supporting these health indicators. These indicators are adiposity, motor development, psychosocial health, cognitive development, fitness, bone and skeletal health, cardiometabolic health, and risks/harm.

For sleep duration, the panel used the nine health categories and subcategories adopted by the AASM during voting in round 1 and 2. These categories were general health, cardiovascular health (cardiovascular disease and hypertension), metabolic health, diabetes, obesity, mental health, mood, psychiatric health, immunologic health, immune function, inflammation, human performance, cognitive performance, driving performance, job performance, cancer (female cancers [breast, ovarian], general cancers, and colorectal cancer), pain, and mortality⁶⁸. (Appendix E below for the round 1 questionnaires).

Round 2

In round 2, the results of round 1 were sent to all experts to reflect on (how the panel as a whole and as individuals rated each recommendation) before the panel members completed the second round of voting.

The expert panel developed the recommendations after completing the second round of voting. The final process included submitting the final recommendations to the Public Health Authority (Appendix F below for the Round 2 questionnaires).



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APPENDIX

Appendix A

External scientific committees

Sleep duration scientific committee

Dr. Siraj Wali

Pulmonary and Sleep Medicine
King Abdulaziz University
Jeddah

Prof. Muslim Mohammed Alsaadi

Pediatric sleep medicine
College of Medicine, King Saud University
Riyadh

Prof. Hamdan Aljahdali

Pulmonary and Sleep Disorders
King Abdelaziz Medical Center
Riyadh

Prof. Adel Alharbi

Pediatrician
Pulmonary and Sleep Medicine
Prince Sultan Military Medical City
Riyadh

Dr. Ghyath Jamil

Pulmonary
Critical care and sleep medicine
King Faisal Hospital & Research Center
Riyadh

Dr. Wadha Helal Alotaibi

Pediatric Pulmonary and Sleep Medicine
King Fahad Medical City
Riyadh

Dr. Aljohara Almeneessier

Family Medicine
King Saud University,
Riyadh

Dr. Abdullah Khayat

Pediatric Pulmonary and Sleep Medicine
Taif University
Taif

Dr. Abdullah Alshamrani

Pediatric Slep Medicine
Prince Sultan Military Medical City
Riyadh

Dr. Muhannad Hawari

Pulmonary and Sleep Medicine
King Faisal Hospital & Research Center
Riyadh

Dr. Sultan Alshahrani

Psychiatrist and sleep medicine
King Abdullah bin Abdulaziz University
Hospital/Princess Norah University
Riyadh

Dr. Ahmed Almutairi

Adult pulmonary and Sleep Medicine
King Abdulaziz Medical City
Riyadh

Dr. Mohammed Albalawi

Pediatric Pulmonary and Sleep Medicine
King Faisal Specialist Hospital & Research
Center
Riyadh

Dr. Ranya Alshumrani

Pediatric Pulmonary and Sleep Medicine
King Abdulaziz University Hospital
Jeddah



Dr. Shaden Alqasraw
Pulmonary and Sleep Medicine
Kingdom Hospital
Riyadh

Dr. Noor Adnan Almodihesh
Child and adolescence psychiatry
King Saud University & Medical City
Riyadh

Dr. Salih Aleissa
Sleep Medicine
King Khalid University Hospital
Riyadh

Dr. Mana Mubarak Alshahrani
Family medicine and sleep medicine
King Faisal Medical City
Abha

Dr. Afnan Adel Shukr
Pulmonary and Sleep Medicine
King Abdulaziz University Hospital
Jeddah

Dr. Mashni Alsaeed
Sleep technology and behavioral sleep
medicine
King Faisal Specialist Hospital
Jeddah

Dr. Mohammed Alhasson
Pulmonary and Sleep Medicine
King Fahad Specialist Hospital
Qassim

Dr. Ali Abdulmana Awadh
Family medicine
University Sleep Disorders Center
King Saud University
Riyadh

Dr. Areej Ayedh Alharthi
Neurology
King Khalid University Hospital
Riyadh

Dr. Riyadh Omar Allehebi
Pulmonary and Sleep Medicine
King Fahad Medical City
Riyadh

Dr. Fawaz Alharbi
Sleep Medicine
Prince Sultan Military Medical City
Riyadh

Dr. Sultan Ali Qanash
Pulmonary and Sleep Medicine
King Abdulaziz Medical City
Riyadh

Dr. Fayez Almutairi
Pulmonary and Sleep Medicine
King Abdelaziz National Guard Hospital
Alhasa

Dr. Ahmad Mansoor Aldobyany
Pulmonary and Sleep Medicine
King Abdullah Medical City
Makkah

Dr. Yousef Alqurashi
Respiratory and Sleep Medicine
Imam Abdulrahman bin Faisal University/
King Fahad University Hospital
Dammam

Dr. Meteb Hamid Alenazi
Psychiatry and sleep medicine
King Saud University
Riyadh

Dr. Saad Alshareef
Pulmonary and Sleep Medicine
Al-Imam University/Melbourne University
Riyadh



Appendix A

External scientific committees

Physical activity and sedentary behavior scientific committee

Prof. Khalid Saleh Almuzaini
Exercise Physiology
King Saud University
Riyadh

Dr. Shaea Ayed Alkahtani
Exercise Physiology & Energy Metabolism
King Saud University
Riyadh

Dr. Mohammad Ali Alahmadi
Exercise Physiology
Taibah University
Madinah

Dr. Abdulazeem Alotaibi
Exercise Physiology
Qassim University
Qassim

Dr. Faisal Awad Barwais
Exercise Physiology
Umm Al-Qura University
Makkah

Dr. Anwar Abdulaziz Alnuaim
Physical Activity & Public health
King Faisal University
Alhasa

Dr. Mohammed Shuaib Alibrahim
Movement Science
King Faisal University
Riyadh

Dr. Huda Ahmad Alaamer
Nutrition & Food Science
Princess Nourah bint Abdulrahman
University
Riyadh

Dr. Baraa Sami Quronfulah
Health Promotion
Umm Al-Qura University
Makkah

Dr. Aqeel Mohammed Alenazi
Physiotherapy & Rehabilitation
Prince Sattam bin Abdulaziz University
Wadi Ad-dawasir



Appendix B:

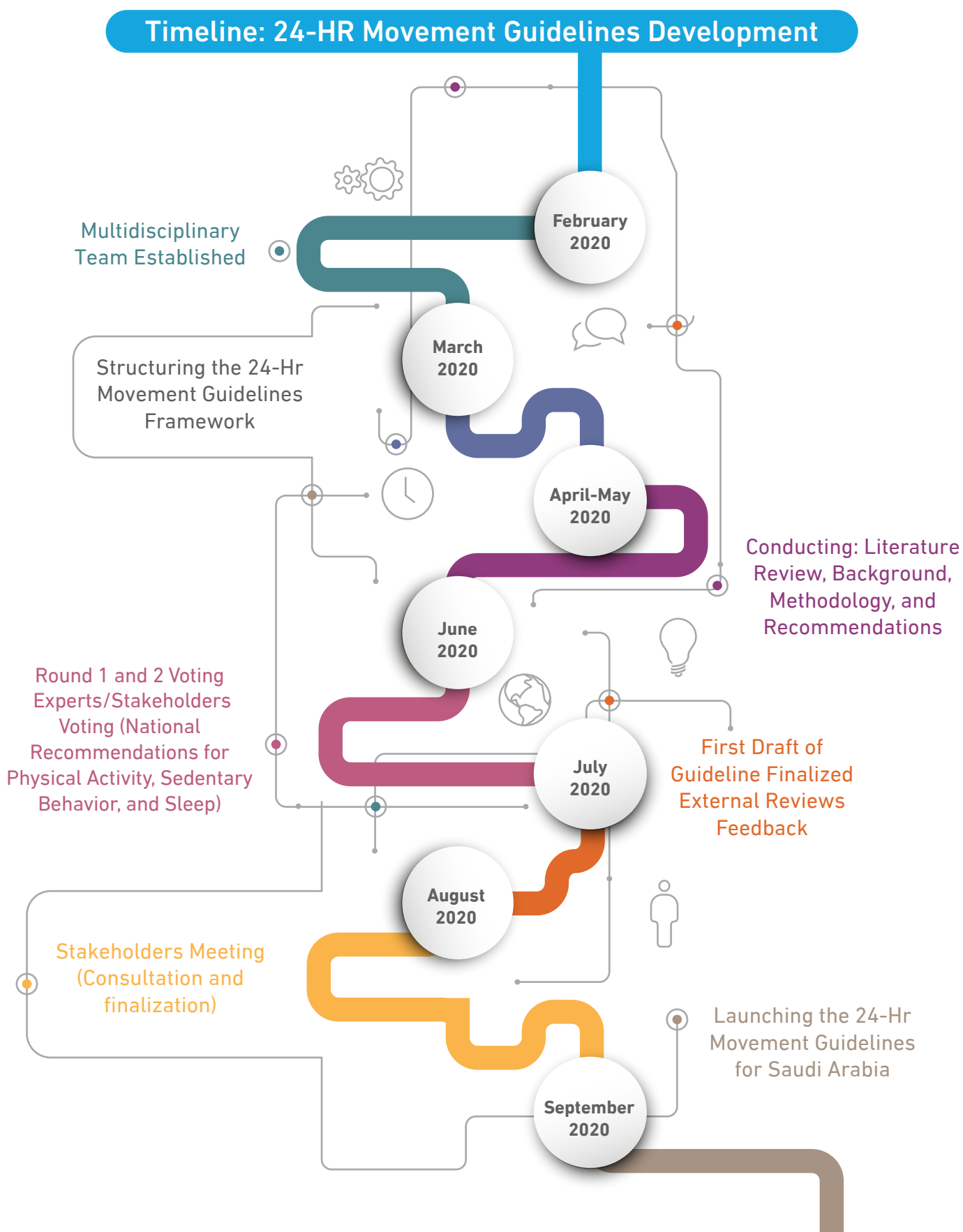
Table 1. Major Saudi health and physical activity initiatives by sectors

Physical activity initiatives	Sector						
	Health	Education	Sport	Urban design	Environment	Transport	Tourism
The Healthy City Initiative	✓			✓	✓		
Ministry of Health initiatives	✓	✓					
Ministry of Education Initiatives	✓	✓					
The Municipalities' Initiatives				✓	✓	✓	✓
The High Commission for the Development of Riyadh		✓	✓	✓	✓		
The Saudi Arabian Olympic Committee and Sports Federations	✓	✓	✓				
The Al-Haraka Baraka physical activity promotional Initiative	✓	✓					
Strategy to Combat Obesity and Promote physical activity in the Arab Countries	✓						
Saudi Arabia is Walking Initiative	✓						
QoL Program 2020	✓	✓	✓	✓	✓	✓	



Appendix C:

Figure 1. Timelines and sequence of events involved in the development of the Saudi 24-Hour Movement Guidelines



Appendix D:

The Participant (Expert-Panel) Information Sheet

https://drive.google.com/file/d/164wK0aPuD0xhXzBURRIKe_jwQgLTZKUG/view

Appendix E:

Voting Round-1 Questionnaires

Recommended physical activity in Saudi Arabia in different age groups to obtain optimal health; Round-1

https://docs.google.com/forms/d/e/1FAIpQLSdw_HhDJMrBWp0JLUXVdvJlaUDqHaAJlvGBE20x21P__4PsMA/viewform

Recommended sedentary behavior in Saudi Arabia in different age groups to obtain optimal health; Round-1

https://docs.google.com/forms/d/e/1FAIpQLSfXK1heB_vsgPdvqRNiJ2C_mLg8zxiOEPT0KXizu1Gx2ylz4w/viewform

Recommended sleep duration in Saudi Arabia in different age groups to obtain optimal health; Round-1

<https://docs.google.com/forms/d/e/1FAIpQLSccgR0cdnq0rcnvPafQGKJFemzi2HTrdisV3Vv31if1v-tXbQ/viewform>

Appendix F:

Voting Round-2 Questionnaires

Recommended physical activity in Saudi Arabia in different age groups to obtain optimal health; Round-2

<https://docs.google.com/forms/d/e/1FAIpQLSe2-dNb1NoQZq3jPKZ-G6GhHYkdwdqliOwqrfYY1q5V4BQtbg/viewform>

Recommended sedentary behavior in Saudi Arabia in different age groups to obtain optimal health; Round-2

<https://docs.google.com/forms/d/e/1FAIpQLSdRHRLTyCu7RB7e-2YiQfdWW3iPxUDFdZil-xBSyGLnLdlfQ/viewform>

Recommended sleep duration in Saudi Arabia in different age groups to obtain optimal health; Round-2

<https://docs.google.com/forms/d/e/1FAIpQLSfmAPZJqCx4dpBAUXQRiLEeU18-0CtuwPE5NMNEEX7pgGFJDQ/viewform>



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