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The Egyptian 24-h movement guidelines for children and adolescents: an integration of physical activity, sedentary behaviour, sleep and eating habits—by the Egyptian Academy of Bone and Muscle health

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Abstract

Background The objectives of this work were as follows: (1) to develop holistic recommendations for physical activity, sleep, sedentary behaviours and eating habits adapted to children and adolescent life stage (5–17 years) and targeting optimal metabolic cycle and achieving energy balance; (2) to provide evidence-based information that can be used by the government, policy makers, healthcare professionals, community, schools as well as families to endorse active, healthy, living in apparently healthy children and youth aged 5–17 years, and as a base for monitoring the activities, particularly the physical ones, on the people level. The Egyptian Academy of Bone and Muscle Health followed an established guideline development process to create the Egyptian 24-h movement clinical guideline for children and adolescents. 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 41 studies met the inclusion criteria. Leveraging evidence from the review of the literature led to the development of 11 key questions covering 8 domains. Fifteen statements focus on the overall identified targets through integration of the movement activities and eating behaviour. Results revealed a major change in the previous basic understandings as it shifts away from segregated into integrated movement behaviour and dietary habit paradigm. Based on this, the final guideline was developed providing evidence-based recommendations for a “Healthy 24-h day”, for Egyptian children and adolescents.

Conclusion The 24-h composition of movement behaviours has principal implications for health at all ages. The developed guideline provides an up-to-date evidence-based recommendation towards a holistic approach for favourable daily life activities and adopts a feasible perspective by outlining these activities within a 24-h period. In addition, eating and dietary elements have been included to complete the energy cycle. Children and adolescents who meet the 24-h movement guidelines generally report more favourable health indicators than those who do not.

Keywords 24-h movement, Guideline, Children, Adolescents, Physical activity, PICO, Sedentary behaviour, Sleep, Eating, Egyptian academy of bone and muscle health

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Background

Recently, there has been increasing interest in public health research and practice related to movement behaviour throughout the day. In 2018, the World Health Organization published its global action plan on physical activity 2018–2030 which provided guiding principles for national efforts to decrease physical inactivity. The plan identified four goals and proposed 20 policy actions. The four objectives are as follows: (1) Create an active society — social norms and attitudes; (2) Create active environments — spaces and places; (3) Create active people — programmes and opportunities; (4) Create active systems — governance and policy enablers [1]. However, such strategic partnership promoting physical activity requires cooperation and interaction of the variable sectors, with the implementation of the advocated national recommendations at all levels.

With such global interest, there have been public health concerns regarding trends in childhood and adolescence physical activity. This highlighted the critical need to understand the importance of integrating all types of activities the subject does within a daily 24-h period. These activities which include physical behaviour (whether light, moderate or vigorous physical activity), sedentary behaviour and sleep, are closely inter-related in terms of time consumption and health benefits [2]. Such interaction was supported by further research which confirmed the strong relationships between these lifestyle behaviours and their health impact particularly the non-communicable diseases [3]. Consequently, this led to the publication of several national guidelines promoting healthy lifestyle behaviours with a focus on specific activities such as physical behaviour [4] or healthy eating habits [5]. This paved the way to redirecting the focus towards achieving all three movement behaviour recommendations and dietary habits, rather than focusing on the attainment of a single recommendation [1, 6].

In Egypt, the progressively sedentary lifestyle of children and adolescents with more time spent on screens and less on physical activity has become a prominent concern. WHO reported the prevalence of physical inactivity among Egyptian adolescents (11–17 years old) at 93% for the girls and 82% for the boys [7]. Other studies reported the prevalence of obesity among Egyptian children at 13.5–23.7% [8, 9]. As physical activity has been considered necessary for normal growth and development, such high prevalence of sedentary lifestyle among Egyptian children has been considered one of the main reasons of childhood stunting in Egypt (the average stunting rate in Egypt in the period of 2005–2016 was 22.3% [10]). Such data reveals the magnitude of physical

inactivity as a national challenge in Egypt and highlight the need for a new movement paradigm that emphasizes the importance of activities occurring over a whole day and the possibility of integrating all these movement behaviours. This shifts the focus from the individual components to emphasize the whole.

This study was carried out aiming the following: (1) to develop guidance to urge Egyptian children and adolescents aged 5–17 years old to adopt a holistic strategy towards optimal metabolic cycle and achieving energy balance. This is based on the integration of all types of activities within a 24-h period. These activities include sedentary behaviour and sleep, light, moderate and vigorous physical activity, as well as eating habits; (2) to provide evidence-based information that can be used by the government, policy makers, healthcare professionals, community, schools as well as families to inspire active, healthy living in seemingly healthy children and youth aged 5–17 years, and as a basis for monitoring physical activity on the people level. This guideline aims to help the Egyptian children and adolescents and their parents organize these activities throughout a day and night schedule and adopt a healthy life aiming for the best health outcomes, minimizing the likelihood of developing chronic disease, unhealthy weight gain and optimize well-being and mental health.

Methods

Scope of the guidelines

This work was conceived by the Egyptian Academy of Bone and Muscle Health. The guideline is for all healthy Egyptian children (aged 5–12 years) and young people (aged 13–17 years) regardless of sex, socio-economic status or cultural background. Children and youth with special needs or medical conditions should consult a qualified medical professional for additional guidance. The guideline development process followed the framework of the “Clinical, Evidence-based, Guidelines” (CEG) initiative protocol [11]. The methodology was designed to minimize bias, maximize transparency and ensure high quality of the systematic reviews. The evidence-based component of the manuscript conformed to the preferred reporting items for systematic reviews and meta-analysis guidelines for reporting systematic reviews [12].

Ethical aspects

This study followed the “Clinical, Evidence-based, Guidelines” (CEG) initiative protocol, and was performed in accordance with the Helsinki Declaration. It was approved by the ethical board of Tanta University. The ethical approval code is 34,842/8/21.

Core team

The core team provided an overview for the development process of the guideline, timelines and responsibilities. The core team also drafted a set of research questions for each of the 3 behaviours: sedentary, and physical activity and sleep and the integration of all these behaviours as well as the eating habits. In addition, the core team reached an agreement on the targeted population, intervention, comparator and outcomes (PICO) [12] (Table 1).

Key clinical questions

The key questions for clinical practice guidelines were defined following a step-wise approach as set by the WHO protocol [13]. The identified key clinical questions are listed in Table 2.

Literature review team

The review of the literature was carried out based on specific research questions under the leadership of 2 experienced consultants with the assistance of an

Table 1 The patient intervention comparator outcome (PICO) approach adopted in this work

Item	Definition
Problem of interest	To achieve optimal metabolic cycle and energy balance among children and adolescents in Egypt and consequently improve their metabolic and general health
Option	A collection of consensus recommendations that set up holistic approach towards reliable metabolic and general health outcomes
Patients	Children and adolescents (5–17 years old)
Intervention	-Reliable and valid physical activity measure, either subjective (e.g. proxy-report questionnaire, or self-report questionnaire) or objective (e.g. direct observation or wearable motion sensors) -For each study, sufficient information was required to determine the physical activity duration, frequency and/or intensity, and involve one measure at least of an identified health indicator
Comparator:	-Separate guidelines targeting different aspects of metabolic health in individual countries -A minimum of one baseline physical activity measure was needed for longitudinal studies. For all experimental studies, a control group was required
Outcomes	<ul style="list-style-type: none"> • Endorsements and health influences of Physical Activity • Advice and health impacts of Sedentary Behaviour • Endorsements and health effects of Sleep • Recommendations and health consequences of Eating Activity • Information and relationships of Physical activity, sleep, sedentary Behaviour, and Eating Activity • Biopsychosocial outcomes: Cardiometabolic health, cardiorespiratory fitness, and respiratory health, motor development, musculoskeletal health adiposity (including the inhibition of unhealthy gain of weight), mental health, academic achievement and cognitive development, negative health outcomes, high-risk behaviours (such as smoking or illicit drug use), conduct behaviour/pro-social behaviour

Table 2 Key clinical questions identified for developing the clinical practice guideline

Domain	
Physical activity:	
Type	What are the types of physical activity required to induce health benefits?
Frequency, intensity, duration	How much physical activity should children and adolescents, aged 5 to 17, do to accomplish the least and ideal health gains?
Outcomes	- What are the positive impacts of physical activities on health outcomes? - What are the negative health outcomes to consider?
Associations:	
	What is the association between physical activity and the health biopsychosocial indicators?
	What are the associations between modes and patterns of sedentary behaviour with health outcomes?
	What is the relation between the duration and pattern of sleep with health outcomes?
Movement breaks:	
	How to introduce movement breaks to limit sitting for extended periods?
	How to manage Sedentary recreational time?
Dietary behaviour	How to balance both social and ecological environment factors to optimize dietary choices?
Integration	What is the association between the integrated 24-h movement behaviours together with eating habits and health outcomes?

expert in methodology. The team concentrated on the myriad of details required to address the gaps and generate the data for each behaviour [14, 15]. The search for articles was carried out for the period from January 2000 till January 2024. Based on the PICO elements identified, keywords were used in different mixtures. Literature searches for PubMed and Cochrane Library databases were carried out on 10th March 2024 and for Embase on 17th March 2024. The individual studies were critically appraised by the reviewers who reflected on the body of evidence, contemplating the studies' scientific validity. Screening of the literature search for duplicate results was carried out electronically. After reviewing the studies (which met the inclusion criteria) identified by the database search strategies and their reference lists, additional relevant research works were retrieved. Recommendations regarding each section were provided based on the revision carried out by each of the experts responsible for the literature review, and the evidence when that was available, and/or on their own experience. The Oxford Centre for Evidence-based Medicine (OCEBM) system [16] was used to determine the level of evidence of each section. The committee circulated the recommendations to national physical activity specialists for commentary.

Inclusion criteria

To be encompassed in the present review, studies should meet these criteria: (1) the study was available in the English language, with full-text availability and published in a refereed journal; (2) the study included original research (clinical guidelines, systematic reviews, randomized controlled trials (RCTs), uncontrolled trials, observational studies including cohort, cross-sectional and case-control studies); (3) the study included one or more valuation of each 24-h movement behaviour, namely, sedentary behaviour, sleep and physical activity; (4) to have a clear methodology described including the PICO elements of the reviewed question.

Exclusion criteria

1. Editorials, conference abstracts, non-evidence-based narrative/personal reviews and commentaries were excluded
2. Studies or clinical guidelines that were confined only to institutionalized – hospitalized populations
3. Studies or clinical guidelines that did not clearly involve children and/or adolescents as a specific population group

Results

Review of the literature

Implementing the described search strategy, 4991 records were retrieved. After excluding 1942 duplicates, 3049 articles were endured for screening. These studies were screened by reading the abstract, and 2918 were disqualified for not meeting the eligibility criteria. A total of 131 full-text articles were then assessed, of which 39 publications met the inclusion criteria and were judged eligible for inclusion. Reviewing the reference lists of all the included articles as well as an up-to-date review of the literature identified two additional studies appropriate for this study. Therefore, a total of 41 studies met the eligibility criteria and were included in this study. These included 5 National 24-hour integrated movement or activity guidelines which were used as reference. These guidelines included the following: the Canadian 24-hour movement guidelines for children and youth [17], the Australian 24-hour integrated movement guidelines for children and young people [18, 19], the Singapore integrated 24-hour activity guidelines for children and adolescents [2], Asia-Pacific Consensus Statement on integrated 24-hour activity guidelines for children and adolescents [20] and Spanish 24-hour movement guidelines during adolescence and its association with obesity at adulthood [21]. In addition, International and national guidelines for physical activity, sedentary behaviour, sleep or eating habits were used as reference, and these guidelines included, but not limited to, the WHO guidelines on physical activity and sedentary behaviour [22], the WHO guidelines on sugars intake for adults and children [23], the American Academy of Pediatrics policy on children, adolescents and the media [24], the American Academy of Sleep Medicine consensus statement on recommended amount of sleep for paediatric populations [25].

Guidelines development process

The targeted population included children and adolescents aged 5–17 years. The Egyptian Academy of Bone and Muscle Health was the organizing body. The professionals involved were experts in pediatrics, rehabilitation medicine, physical activity and health promotion, epidemiology, guidelines development, as well as psychology. Consensus was achieved following multiple online meetings followed by online comprehensive feedback.

Results of the systematic review

Definitions

This guideline provides evidence-based public health recommendations regarding the types and amount (duration, intensity, frequency) of physical activity, (examples of these activities are shown in Fig. 1 that present

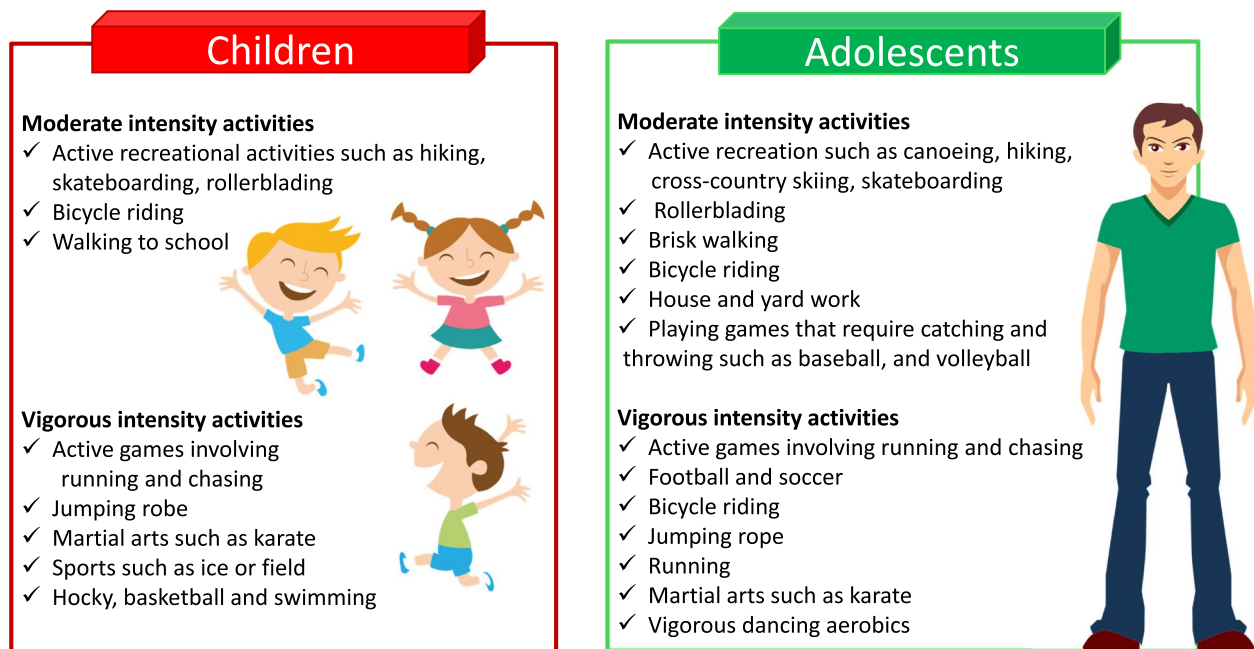


Fig. 1 Examples of the physical activities in both children and adolescents

substantial health benefits and mitigate health risks. Table 3 shows definitions of these activities in both children and adolescents.

Health outcomes

Guided by the key questions, the systematic review was carried out to identify the impact of the movement behaviours and eating habits on health outcomes together with their level of evidence. These are summarized in Table 4.

The Egyptian 24-h movement guidelines

Considering the overall health benefits, children and adolescents aged 5–17 years should be physically active every day, ensure having sufficient sleep and minimize sedentary behaviour. Greater health benefits can be achieved by replacing sedentary behaviour with extra physical activity and trading light physical activity to more moderate to vigorous physical activity, whilst continuing to have adequate sleep.

Overarching principles

1. Positive health benefits in children, as well as adolescents are independently associated with high levels of physical activity, low levels of sedentary time and optimal sleep duration, as well as diet.
2. As the 4 behaviours, physical activity, sedentary, sleep and eating behaviours should be considered simultaneously, as they are co-dependent and distributed across the whole day (24-h period).
3. Meeting all the four 24-h movement guidelines has been linked in children, and adolescents to positive physical outcomes (e.g. motor development, physical fitness, adiposity, cardiometabolic health), cognitive benefits (e.g. cognitive ability, academic performance,) as well as positive biopsychosocial impact (e.g. health-related quality of life and well-being).
4. Adequate physical activity levels in children and youths have health advantages both in the present and future. Some physical activity is better than none, and more activity is better than some activity.
5. A healthy integration of the 24-h movement behaviours is vital for health promotion and disease prevention across the lifespan.
6. Reallocation of the time spent in sedentary behaviour, to light physical activity and moderate to vigorous physical activity, has been associated with better health outcomes (reductions in indicators of adiposity [BMI (body mass index), waist circumference and body fat percentage] as well as reduced mortality risk in all age groups).

Table 3 Definitions of movement activities in children and adolescents

Physical inactivity	No activity except baseline daily activities
Sedentary behaviour	Activities considered sedentary are sleeping, lying down, sitting, watching TV, reading, using a computer and travelling by car, bus or train as minimal muscle energy expenditure is required
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	
Definition	<p>Sedentary</p> <p>Any waking behaviour whilst in a sitting, reclining or lying posture</p> <p>Light intensity</p> <p>moving rather than sitting or lying down</p> <p>Moderate intensity</p> <p>Will make the breathing faster and raise the heart rate and feel warm (simply the person can not sing, but can talk)</p> <p>Vigorous intensity</p> <p>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)</p>
Examples	<p>Sitting, reclining or lying down</p> <p>Light physical activities can range from static (e.g. standing) to dynamic (e.g. slow walking)</p> <p>Walking to school or walking the dog</p> <p>Playground activities, including jumping, running and catching</p> <p>Physical education</p> <p>Sports, like football or tennis</p> <p>Swimming</p> <p>Skipping</p> <p>Dancing</p> <p>Skateboarding or rollerblading</p> <p>Cycling</p> <p>Aerobics, martial arts, running, fast bike riding or on a hill, swimming, playing single tennis or football, dancing for fitness</p>
Physical activity intensity assessment:	
Relative: Visual Analogue Scale (VAS 0–10)	
Durations	<p>Sedentary</p> <p>0–1.9</p> <p>Moderate intensity</p> <p>60 min of moderate or vigorous intensity physical activity a day across the week</p> <p>Light intensity</p> <p>2–4</p> <p>Moderate intensity</p> <p>5–6</p> <p>Vigorous intensity</p> <p>≥7</p>
Frequency	<p>Muscle strengthening at least 3 times a week</p> <p>Moderate to vigorous activity</p> <p>Every day</p> <p>Multicomponent activities</p> <p>3 or more days a week</p> <p>Sedentary</p> <p>No more than 2 h per day; Breaking up long periods of sitting as often as possible</p> <p>Sleep</p> <p>5–13 years: 9 to 11 h of sleep per night; 14–17 years: 8 to 10 h per night</p>

Table 4 Statements concluded from the systematic review regarding the movement behaviours and eating habits and the impact of each of them on health outcomes together with their level of evidence

Movement behaviour	Statements	Evidence
Physical activity	* Higher levels of physical activity are associated with multiple health benefits in this age group (5–17 years)	A
	* Physical activities are associated with specific health outcomes: cardiometabolic health; adiposity (including the prevention of unhealthy weight gain); musculoskeletal health; mental health; and cardiorespiratory fitness	A
	* Duration: To achieve health benefits, children and young people should participate in a minimum of 60 min of at least moderate intensity physical activity, 3–5 times per week	C
	* Smaller amounts of physical activity (i.e. 20–40 min) are also associated with health benefits	B
	* Dose–response relationship: A greater frequency and/or intensity of physical activity was associated with even greater health benefits	B
	* Type:	
	-Physical activity of a vigorous intensity is necessary for musculoskeletal and cardiorespiratory health benefits ^a	
	- A variety of aerobic physical activities provided health benefits for a majority of the selected health outcomes	
	- weight-bearing, high-impact, or high-intensity exercises (3 times a week) have been found to be beneficial for musculoskeletal and cardiometabolic health	
	Conclusion: The benefits of physical activity is associated with several health benefits and outweigh the harms	
Positive health outcomes:	* Cardiometabolic: Regular physical activity, at least for 60 min/day reduce the cardiometabolic risk [lower diastolic blood pressure (at the age of 14 years), lower triglycerides and glucose levels]	A
	* Adiposity: A wide range of physical activities have been shown to have a positive effect on measures of adiposity, including endurance activities, aerobic activities, sport-based games, sports training, active play, plyometric exercises, and resistance training	B
	* Skeletal Health: higher-impact physical activities, Jumping, sport participation, aerobic and resistance exercises have significant benefits to skeletal health including BMC and BMD	B
	* Muscle health: a variety of activities produce gains in muscular health	A
	-Gains in muscular health (muscle strength, power and endurance) have been reported associated with activities of a vigorous intensity undertaken on 2 to 3 days per week, whilst moderate-intensity activities such as organized sports are required on 3–5 days per week in order to produce benefits	B
	- Aerobic and strength exercises such as lunges, squats, star-jumps, jogging and dancing, undertaken for 30 min per school day led to gains in muscular strength and flexibility	
	- Muscle flexibility was reported to be enhanced through weight-bearing and resistance training, taekwondo training, football training, and dance training	
	-School: a variety of aerobic and strength exercises such as lunges, squats, star-jumps, jogging and dancing, undertaken for 30 min per school day led to gains in muscular strength and flexibility	
	* Mental Health: there is significant relationship or impact of physical activity on mental health	
	-A minimum of moderate- to vigorous-intensity physical activity at least three days per week for 60 min each day had a significant effect on mental health (quality of life; depression; anxiety; self-esteem; physical self-perceptions; anger and emotional problems and; perceived stress	
- Dose–response relationship between the frequency, intensity and duration of physical activity and mental health		
* Cardiorespiratory Fitness:		
- Physical activity has positive impact on cardiorespiratory fitness		
- A combination of moderate- and vigorous-intensity physical activity was necessary to bring about gains in cardiorespiratory fitness		
- Type of exercise: aerobic activities, sports training and active games as well as resistance and plyometric activities showed benefits to cardiorespiratory fitness		
* Conclusion: The positive benefits of physical activity has positive benefits/ impact on health outcomes		
Negative health outcomes	* Stress fractures: children and adolescents who participated in > 4 h per week were more likely to suffer stress fractures (Low evidence)	D
	* High-Risk behaviour: Adolescents (16 years old) who participated in physical activity less than 3 times per month were more likely to be intoxicated weekly, experience alcohol-related problems and use drugs, than those who exercised 4 or more times per week	D

Table 4 (continued)

Movement behaviour	Statements	Evidence
Biopsychosocial outcomes (school)	* Academic/Cognitive Development: - School—weekly vigorous physical activity had a positive impact on children’s school grades - Positive association between increases in physical activity and increases in academic achievement or cognitive development - Physically active academic lessons, including 10 min of MVPA nine times per week, increased academic achievement scores - Cognitive ability: physical activity (30 min of MVPA on 3 days per week or aerobic physical education lessons for 1 h, twice per week) has been shown to have a beneficial impact upon the overall cognitive ability including spatial and working memory, executive function, and fluid intelligence - Dose–response relationship with higher intensities and longer durations of physical activity associated with greater cognitive benefits * Behavioural conduct - Physical activity breaks during the school day on have positive impact on the classroom behaviour - Physical activity (up to 30 min of light and moderate- to vigorous-intensity physical activity breaks) in 11–14-year-olds was not associated with any behavioural problems one year later, including peer problems, conduct problems, or pro-social behaviour * Motor development: - Weight training activities at least three days per week had positive benefits for motor skills and abilities - Football (soccer) training, performed 3 times per week for 60 min at 80% of maximum heart rate had a beneficial effect on the generic motor skills - Impact-loading, weight-bearing activity programme 2 days per week for 50 min had significant increases in upper body coordination	B C C
Sleep behaviour	* 5–13 years: Uninterrupted 9 to 11 h of sleep per night * 14–17 years: 8 to 10 h per night with consistent bed and wake-up times * Sleep duration and quality: significantly impact child and adolescent health, as shorter sleep duration is associated with childhood obesity	A
Sedentary behaviour	* “Physically inactive” is a term used to describe those who do not meet the minimum level of physical activity that is specified by relevant physical activity guidelines * Physical inactivity has associated health risks	NA
Eating habits	- Good eating habits: regular meals consisting of nutritionally balanced foods and drinks - Together with consumption of nutritious foods and drinks, - Balance the metabolic cycle by supplying energy for daily activities, growth and development	A

^a Insufficient evidence to make a recommendation on the frequency of vigorous physical activity that is required for such benefits

7. It is important to encourage physical activities for children and youths across different perspectives including at school, home and in the community.
8. It is mandatory that school curricula should include regular physical education lessons as a standard of the educational day.
9. It is highly encouraged to replace sedentary activity with light, moderate or vigorous physical activity on a daily basis.
10. In setting these recommendations, the 24h movement guidelines provide guidance to healthcare professionals, decision makers, researchers, educa-

tional authorities and the general public as it establishes measurable targets for surveillance.

11. This guideline could be used to develop national campaigns, programmes as well as policies for the schools and the public to promote healthy movement and eating behaviours and be used to compare these behaviour practices among the children and adolescents between various authorities.

Statements

To achieve a healthy 24-h, children (aged 5–12 years) and young people (aged 13–17 years) should:

I. Physical activity

1. Intensity:

- Build up a daily moderate to vigorous physical activity for an average of 60 min or more, where more is better.
- Throughout the day, participate in a mixture of light-intensity physical activities as often as possible.
- When engaging in physical activity, take the necessary precautions and seek medical advice if any discomfort is felt.

Summary of evidence

As higher levels of physical activity are associated with greater movement competencies [26], for children and adolescents, to be able to achieve substantive health benefits, they should aim to accrue an average of ≥ 60 min of physical activity (this includes active or outdoor play, sports, games, planned exercise and physical education or transportation) per day in a week. At least, most of these activities should be of moderate intensity [27, 28]. Setting a target such as reaching an accumulated 12,000 steps/day may also help children and youths meet the recommended daily physical activity [28, 29]. However, wherever possible, vigorous-intensity activities should be incorporated for better health gains [30].

2. Bone and muscle strengthening

For all children and adolescents, bone and muscle strengthening exercises should be integrated into their physical activity regime.

Participate in bone and muscle strengthening activities at least three times a week.

Summary of evidence

The inclusion of the bone and muscle strengthening activities endorses gains in strength and promotes the development of healthy bones and strong joints, which are important for optimum development and growth [26, 31, 32]. This, in turn, helps to improve exercise performance, prevent injuries and minimize the likelihood of developing bone- or muscle-linked health problems in the future [26, 32].

These exercises include movements that involve the carriage of body mass to an array of activities. This ranges from weight-bearing activities, resistance exercise using body or light weights, or dynamic

light-impact exercises such as jumping, hopping or skipping [26, 31]. This could be part of the daily minimum accumulation of 60 min of moderate- to vigorous-intensity physical activity.

Practicing safe and correct bone and muscle strengthening activities under appropriate supervision such as school sport or physical education, on a regular basis, helps to minimize the possible risks of injury, concomitant surge in the muscle size or any other negative impact on the physical growth [33].

3. Having regular breaks to move

Consider regular breaks *to do* light physical activity or move around during times of inactivity or prolonged sitting.

Encouraging play, rather than extra sedentary time during leisure period, is a vital contributor to overall movement.

Summary of evidence

There will be inevitable periods when children are needed to remain seated for lengthy periods. This may vary in the daily routine, for example during lessons in the school, during some social recreational or cultural activities, or long-distance travelling. Such attitude of sedentary behaviours among children and youths got worse following the COVID-19 epidemic [34], as online and social interactions and lessons have added extra screen time to the sedentary behaviours among children and youths. The WHO guidelines on physical activity and sedentary behaviour published in 2020 acknowledged the detrimental effects of sedentary behaviour on the fitness, adiposity and behaviour or sleep among children and adolescents [35].

To combat such negative damaging impact of sedentary life on the children's health, particularly when such inactivity periods are unavoidable, it is imperative to include frequent breaks to promote regular movement and physical activity. This not only impacts on the child's overall physical activity levels [36], but it is also beneficial for their social and mental health [37]. These activity breaks also help improve the children's concentration abilities in school. Fifty-one such breaks may vary from just a few minutes of "5-min movement break" (i.e. intervals for movement and physical activity) for every 30–60 min of sedentary time, together with active physical play during break times. Such recovery breaks not only help reduce the negative impact of prolonged inactivity but also aid to enhance the children's concentration during school lessons [38].

4. Precautions

All the necessary precautions should be considered before, during and after exercise. It is vital to seek medical advice should the child or adolescent feel unwell during the exercise.

Summary of evidence

Though physical activity benefits outweigh its risks, safety is a key factor in doing any physical exercise or organized sports. In addition to ensuring the child's well-being, it also makes certain continued involvement in sports and exercise in the long term [39].

Good practices can be stratified into:

1. Personal level: this includes performing warm-ups before, and cool-down stretching post activity; wearing appropriate clothes and footwear as well as maintaining proper hydration is also vital [40].
2. Environmental: this includes using the appropriate equipment and weights; exercising in conditions that are free of hazards (such as broken equipment and uneven surfaces), apply protective sprays/creams against the sun and insects when physically active outdoors and avoid exercising in extremely hot and humid outdoor activities [41].

The children and adolescents should fully understand and adhere to the game rules and there should be appropriate conditioning in the aspects of fitness, strength and flexibility [42].

II. Sedentary behaviour

The period allocated for sedentary/ recreational screen time should be restricted to 2 h or less per day.

Summary of evidence:

Similar to all other behaviours, sedentary screen time can be a friend and a foe. Whilst having screen-based activities is favoured by most of the children and adolescents, recreational activities of more than 2 h a day have been linked to the most adverse health outcomes [43, 44]. Higher incidence of adiposity, progressive worsening of motor and cognitive development, as well as negative impact on psychosocial health have been reported in association with screen-based sedentary behaviour [45, 46]. It also enhances unhealthy dietary behaviours, which are substantial risk factors for overall poor health [47].

Examples of recreational screen time activities include electronic gadgets use (such as computer, mobile phone and tablet), engaging into physically non-active video games and television viewing [23].

Therefore, it is imperative that such sedentary behaviour should be addressed by providers. This can also be endorsed by parenting strategies, aiming to assessing the duration and use of recreational screen time, and limiting it as much as possible [45, 48].

III. Sleep behaviour

Have regular uninterrupted daily sleep of 9–11 h per night (for 7–13-year-olds) and 8–10 h per night (for 14–17-year-olds) with consistent bed and wake-up times.

Summary of evidence

Sleep is an integral constituent of mental and physical health for children, adolescents as well as adults. Unfortunately, in children and adolescents, there is a tendency to reduce their sleeping times to make more time for their daytime activities. Adequate duration of regular sleep has been associated with better health outcomes in terms of mental and physical health, quality of life, attention, memory, learning, behaviour, academic achievements as well as emotional regulation [49]. According to the current evidence, insufficient sleep increases the risk of injuries/accidents, especially during physical activity, and over the long term, it has been linked to obesity, diabetes, hypertension and depression [42, 50].

Though, to accumulate the endorsed period of sleep, some children may opt for having naps during the day, it is highly advised to achieve these recommendations through night-time sleep.

IV. Eating behaviour

Dietary recommendations in children and adolescents: To support the child's growth and daily activities, take the recommended amounts of foods and drinks that are nutritious and balanced [51, 52].

Summary of evidence

Diet plays a chief role in the individual person's health. The World Health Organization has defined a healthy diet as "includes high consumption of fresh fruits and vegetables, daily breakfast consumption and discourages routine consumption of nutrient-poor foods that are high in sugars, saturated fats, trans fats and salt" [53]. Having a

healthy diet is of utmost importance during childhood to establish optimum nutritional habits and sustain growth. The ecological and social environment can effectively influence the dietary choices of the individual and their families [45]. Therefore, being aware of the child-specific dietary guidelines alone is not enough to endorse behavioural change [54], hence the importance of setting up the dietary recommendation for children and adolescents. Purposeful choice of food and drinks, in suitable quantities for the corresponding age, is integral to reaching a healthy eating habit so as to endorse the child's or youth's growth, activity and development.

Considering the social factor, parental modelling/authoritative style of parenting, a fixed household eating routine provides applicable solutions for synchronized family meals and appetite regulation, consequently impacting on the quality of the children and adolescents' diet [45, 48]. Having as part of daily routine, a nutritious breakfast is strongly endorsed and has been reported to have positive outcomes, including healthy body weight and better diet quality [48]. A nutritious breakfast should include foods from the major food groups without added sugars (e.g. rolled oats with fresh fruit and yoghurt, whole grain bread with boiled eggs and milk) [55].

To fulfil nutrient requirements, it is important that the standard meal includes a diverse range of foods from all food groups in age-appropriate portions [55–58]. Nutritionally balanced foods and drinks should include elements from major food groups (such as whole grains; poultry, lean meats, seafood; vegetables, legumes and fruits). In addition, selected choices of low saturated fat (e.g. low-fat dairy products, foods free of saturated and trans fats, foods prepared with limited solid fat, e.g. butter) [59–61]. Incorporating key food groups on a plate can be used to ensure appropriate meal portions, for example, having vegetables and fruits comprising half of the plate, rice and grains forming a quarter and protein-rich food forming a quarter [56, 62]. Visual aids can be used to help ensure suitable food portions. An example is the “My Healthy Plate”, a visual guide designed by the Singapore Health Promotion Board [2].

To minimize the risk of increased adiposity, getting overweight, the consumption of added sugars, sugars naturally present in honey, fruit juices, syrups and fruit juice concentrates, as well as sugar-sweetened beverages should be limited to no more than 10% of the total

energy intake [2]. The WHO released an extended recommendation regarding free sugars and advised limiting free sugars intake to not more than six teaspoons per day (approximately 25 g per day) [63, 64].

XXII. Integration

For optimal health and development, it is highly advisable to integrate all the recommendations for physical activity, sleep and sedentary behaviours as well as eating habits.

Summary of evidence

Adopting good habits during childhood may pay surpluses later in life. Physical activity, sedentary and sleep behaviours as well as eating habits are modifiable risk factors, yet inter-related. In the first years of life, sleep patterns evolve and are vital for efficient cognitive and physical development [65, 66]. In children and adolescents, sleep deprivation has been connected with poor eating habits, lower school performance and obesity [67, 68]. In concordance, poor sleep has been linked to a decrease in physical activity, dysregulation of appetite control and an increase in sedentary behaviour such as screen time, which may ultimately lead to weight gain [69, 70]. Sedentary behaviour, especially watching TV, have also been positively correlated to sleeping disorders [71, 72] and obesity [73–75]. An increase in physical activity was reported to be associated with a reduction in sedentary behaviour which in turn led to a better quality of life related to health [76–78]. Therefore, for the best health outcomes, it is imperative that more of the recommendations on physical activity, sedentary, sleep and eating behaviours are met by the children and adolescents.

All the recommendations are of comparable value, achieving optimum level of the recommendations in any mixtures (such as moderate-vigorous physical activity and low sedentary behaviour, high moderate physical activity and adequate sleep, or low sedentary behaviour and adequate sleep) can result in comparable health outcomes in terms of adiposity and cardiometabolic health [20].

Cultivating a cultural change particularly health education in the society and the important role of the family as well as the school is imperative to facilitate the implementation and gradually meeting of these recommendations into the children and adolescents' standard lifestyle. This in turn is expected to decrease the burden of the non-communicable diseases in adulthood [79].

Movement activities	Physical Activity	Sedentary Behaviour	Sleep
Recommendation "1"	Average of at least 60 minutes of moderate or vigorous intensity physical activity a day across the week	Limit to 2-hours or less	Good-quality sleep -5-13 years: 9 to 11 hours per night -14–17 years: 8 to 10 hours per night
Examples	<p style="text-align: center;">Examples of weekly programs</p> <p>These activities could include active transportation (walking or cycling), recreational activities (active play or camping) and planned physical activities or sport programmes.</p> <p>Vigorous physical activities, and muscle and bone strengthening activities should each be incorporated at least 3 days per week</p> <p>Light physical activities: Several hours of a variety of structured and unstructured light physical activities;</p>	<p>-No more than 2 hours per day of recreational screen time</p> <p>- ensure movement breaks</p> <p>- Limited sitting for extended periods.</p>	Uninterrupted sleep on a regular basis with consistent bed and wake up times.
Recommendation "2"	Muscle-strengthening activities		
Description	Engage in muscle- and bone-strengthening exercises at least 3 times a week. This could be part of the daily minimum accumulation of 60 minutes of moderate- to vigorous-intensity physical activity. A variety of types and intensities of physical activity across the week to develop movement skills, muscles and bones		
Examples	These exercises range from weight-bearing activities, resistance exercise using body or light weights, or light-impact exercises such as skipping, hopping or jumping.		
Recommendation "3"	School Activities		
Description	The school is an ideal setting in which to increase physical activity and reduce sedentary behaviour sleep behaviour should be incorporated into school based interventions to improve children’s health		
Exercise	<ul style="list-style-type: none"> occur on a minimum of three days per week; and, be a minimum of 40-70 minutes in duration on each occasion. 		
Examples exercises	Physical education, playground activities, including jumping, running and catching, sports, like football or tennis, swimming, skipping		
Recommendation "4"	Eating Habits		
Approach	Parental modelling Optimise growth, maturation and development Regular household eating routine Coordinated family meals Regular meals consisting of nutritionally balanced foods and drinks to support daily activities conscious selection of food and drinks in age appropriate portions that support a child’s activity levels and growth Suitable portions can be planned using visual aids, e.g. “My Healthy Plate” Consuming a nutritious breakfast as part of a daily routine		
<p>For optimal health benefits, children and youth (aged 5–17 years) should achieve high levels of physical activity, low levels of sedentary behaviour, and sufficient sleep each day.</p> <p>Greater health benefits are attained when: ensure sufficient sleep, ensure movement breaks, swap indoor time for outdoor time, and replace sedentary behaviours and light physical activity with additional moderate to vigorous physical activity.</p>			

Discussion

From a movement prospect, the 24-hour period is distributed among eating habits, sedentary and sleep behaviours, as well as physical activity on a continuum from no movement to high movement. Initially, studies were carried out highlighting the discrete health benefits of high physical activity, low sedentary behaviour and adequate sleep among children and adolescents [80–85] as well as adults [86–88]. Until lately, the health implications of time spent in each of these movement behaviours have traditionally been evaluated in isolation or with only partial adjustment for time spent in other movement behaviours [89]. Recently, research studies started to evaluate the combined effects of the 24-h movement behaviours on health. Findings revealed that specific combinations of the movement behaviours (e.g. high physical activity, low sedentary behaviour and sufficient sleep) are linked to optimum health indicators for the early years (0–4 years old; e.g. motor development, fitness) and for children (5–11 years old) and youth (12–17 years old; e.g. cardio-metabolic health and adiposity) [90, 91]. More recently, using isotemporal substitution methodologies, studies have assessed the relation between health indicators and the reallocation of a fixed duration of one movement behaviour for another, [92, 93]. Consistent with this integrated vs. segregated movement behaviour and dietary habit paradigm, the Egyptian 24-Hour Movement Guidelines for children and adolescents (aged 5–17 years old) adopted the integrated approach.

This work was carried out aiming to develop holistic recommendations for physical activity, sleep, sedentary behaviours and eating habits adapted to children and adolescent life stage and highlight the value of integrating these behaviours. The inclusion of the dietary habits in such guideline has been adopted in the recently published guidelines [2, 20] for children and adolescents. In contrast, the Canadian 24-hour movement guidelines for children and youth included only the integration of physical activity, sedentary behaviour and sleep [17]. The intimate relationship between health, sedentary and sleep behaviours, physical activity and eating habits has been defined as “conscious, collective and repetitive behaviours, which lead people to select, consume, and use certain foods or diets, in response to social and cultural influences” [65]. Recently published research works demonstrated a deep connection between physical activity, sedentary behaviour, sleep and dietary habits. The quality and behaviour of the dietary habits and the movement behaviours are also interdependent and directly involved in the health and quality of life of young people [94, 95] and adults [96, 97].

The developed guideline highlighted the important role of the society particularly schools in implementing these recommendations through health education. School plays a fundamental role for boosting healthy behaviours in both children and adolescents, as the majority of the children and adolescents spend half their daily waking time at school [98]. In addition, schools offer a context that is easily delivered to the majority of children. Such approach is provided through an intervention setup, regardless of children’s gender, background characteristics, ethnicity or socio-economic status [99]. Moreover, schools are an ideal health promotion setting as they can reach not only children and adolescents but also several other target groups such as teachers, school staff, families and even members of the local community [100].

Though the implementation of these guidelines is beyond the scope of the current development process, the guideline development committee recommended that these guidelines be integrated into all relevant government programmes and policies. Specific goals have been contained in the guideline for monitoring outcomes (e.g. engage in 60 min of moderate to vigorous physical activity each day, body weight and height). Another limitation is that the methodology implemented in this work included the inclusion of just research works published in the English language. Thirdly, though the recommended durations for the physical activity, sedentary time as well as sleep have been based on current international guidelines and/or consensus, more evidence on the precise dose–response relationship between these behaviours and healthy outcomes is required.

In conclusion, the rapid socio-economic transitions in Egypt have made the country ill prepared for public health challenges particularly among children and adolescents. Stunting remains an important challenge in Egypt, which affects approximately one-third of children < 5 years of age [101, 102] alongside the raising prevalence of overweight and obesity, food insecurity and micronutrient deficiencies [103, 104]. As the 24-hour composition of movement behaviours and dietary habits have important implications for health at all ages, this guideline has been developed as a tool to provide a framework to tackling such challenge. The developed guideline provides the latest evidence-based endorsements towards a holistic strategy for favourable lifestyle activities and adopts a practical prospect by outlining these activities within a 24-hour period. In addition, eating and dietary components have been contained to accomplish the energy cycle. Children and adolescents who meet the 24-h movement guideline recommendations generally are expected to report more beneficial health indicators than those who do not.

Abbreviations

CEG Clinical, evidence-based, guidelines
 PICO Population, intervention, comparator and outcomes
 WHO World Health Organization

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Consent for publication

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Competing interests

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