



The Director General

Maisons-Alfort, 23 December 2015

OPINION

of the French Agency for Food, Environmental and Occupational Health & Safety

on the "Updating of the PNNS guidelines: Revision of the guidelines relating to physical activity and sedentarity"

*ANSES undertakes independent and pluralistic scientific expert assessments.
ANSES's public health mission involves ensuring environmental, occupational and food safety as well as assessing the potential health risks they may entail.
It also contributes to the protection of the health and welfare of animals, the protection of plant health and the evaluation of the nutritional characteristics of food.*

It provides the competent authorities with the necessary information concerning these risks as well as the requisite expertise and technical support for drafting legislative and statutory provisions and implementing risk management strategies (Article L.1313-1 of the French Public Health Code).

Its opinions are made public.

This opinion is a translation of the original French version. In the event of any discrepancy or ambiguity the French language text dated 23 December 2015 shall prevail.

On 5 April 2012, ANSES received a formal request from the Directorate General for Health (DGS) to undertake the following expert appraisal: Updating of the PNNS guidelines: Revision of the guidelines relating to physical activity and sedentarity.

1. BACKGROUND AND FRAMING OF THE REQUEST

■ Background

On 5 April 2012, the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) received a formal request from the Directorate General for Health (DGS) with a view to updating the nutritional guidelines of the French National Health & Nutrition Programme (PNNS). The formal request was worded as follows: "ANSES is requested to propose a new formulation for the PNNS nutritional guidelines, including those concerning physical activity [...]".

As a reminder, the PNNS was established in 2001. It has since been renewed twice successively: PNNS 2006-2010 and PNNS 2011-2015.

The PNNS is a national public health programme that aims to improve the state of the population's health by acting on nutrition, a major determinant of health status. With regard to the importance of physical activity, the subject of the formal request, the DGS states in its letter: "The French National Health & Nutrition Programme 2011-2015 formulates various principles. They mention in

particular *the PNNS nutritional guidelines aiming to promote a diet and a physical activity that foster an optimal nutritional and health status.*"

The term "nutrition", as used in the PNNS, encompasses all the issues relating to diet (nutrients, foods, social, cultural, economic, sensory and cognitive determinants in dietary behaviour) and to physical activity, in relation to health.

The Agency decided to deal with the DGS's request by distinguishing between the questions relating to physical activity (PA) and those relating to dietary guidelines. The present opinion only addresses the PA and sedentarity part of the question, with the aim of proposing guidelines for the general population in primary prevention, whose aim is to reduce the incidence of a disease within a population and therefore to reduce, as far as possible, the risk of the emergence of new cases (WHO, 1948).

■ Framing of the request

On the basis of the DGS's request, ANSES considered it appropriate to frame the questions it would address by taking into consideration:

- practices of PA and sedentarity according to the characteristics of the population: age, gender, state of pregnancy, functional limitations;
- the characteristics of the different types of PA:
 - o according to the nature of the physiological effort (cardiorespiratory, muscle strengthening, etc.);
 - o according to the context (occupational, transport, domestic and leisure);
 - o according to the environment;
- the identification of factors able to positively or negatively influence the practice of PA and sedentary behaviour;
- the effects of PA and physical inactivity on some of the risk factors for chronic diseases;
- the health risks associated with the practice of PA;
- the health risks associated with sedentary behaviour.

Major scientific studies have previously been conducted by national and international organisations on the links between PA and health status, as well as on the determinants of behaviour regarding PA and sedentarity. The recent work includes a multidisciplinary collective expert appraisal carried out in 2008 by INSERM¹: *Activité physique - Contextes et effets sur la santé [Physical activity - Contexts and effects on health]*. In addition, an INSERM expert appraisal report on social inequalities considered these questions from a socio-economic point of view (INSERM, 2014).

ANSES decided to consider the INSERM collective expert appraisal (2008) as the initial knowledge base, to supplement it by the most recent scientific publications, and to extend the scope of the expert appraisal to other current issues relating to PA. This approach enabled it in particular to develop the role of sleep and its relationship with PA, and to investigate and propose recommendations intended for people with a functional limitation of activity (FLA). Other points were taken into account, aiming to characterise the risks associated with the practice of PA in a polluted atmosphere, and to clearly distinguish between issues relating to PA and those relating to

¹ French National Institute of Health and Medical Research

sedentarity. This ultimately led to the existing recommendations on physical activity being refined, and recommendations on sedentary behaviour being established.

2. ORGANISATION OF THE EXPERT APPRAISAL AND METHOD

■ Organisation of the expert appraisal

The expert appraisal was carried out in accordance with French standard NF X 50-110 "Quality in Expert Appraisals – General requirements of Competence for Expert Appraisals (May 2003)".

The issues being appraised fall within the scope of the Expert Committee (CES) on Human Nutrition. ANSES entrusted the expert appraisal to the Working Group (WG) on "Updating of the PNNS guidelines: revision of the guidelines relating to physical activity and sedentarity" and two rapporteurs from the CES. The methodological and scientific aspects of this group's work, as it progressed, were presented to the CES and discussed in meetings between 24 January 2013 and 18 December 2014. They were adopted by the CES on Human Nutrition, which met on 25 June, 10 July and 3 December 2015.

ANSES analyses the links of interest declared by the experts prior to their appointment and throughout the work, in order to avoid potential conflicts of interest with regard to the matters dealt with as part of the expert appraisal.

The experts' declarations of interests are made public via the ANSES website (www.anses.fr).

■ Method

An analysis of the scientific literature was conducted using PubMed and Web of Science, in particular by cross-referencing keywords relating to PA and sedentarity with keywords specific to the different themes, and broken down according to the characteristics of the population (age, gender, etc.). In total, 1975 studies were selected by the experts for the analysis.

The WG also conducted hearings with:

- regional health networks: Saphyr in Lorraine and EfforMip in Midi-Pyrénées;
- the French Society for Exercise and Sport Medicine (SFMES);
- the French Society of Professionals in Adapted Physical Activity (SFP-APA).

3. ANALYSIS AND CONCLUSIONS OF THE CES AND THE WG

■ Preamble

• Definition of physical activity (PA)

PA is defined here as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen et al., 1985). PA encompasses all the activities that can be practised in different contexts, while pursuing varied objectives (utility, health, social, etc.). The main contexts for practising PA are work, transport, domestic activities and leisure. The latter includes exercise, sport and unstructured recreational PA.

- **Definition of physical inactivity and sedentariness**

Physical inactivity is defined as an insufficient level of moderate to high intensity PA. It relates to a level below a recommended threshold of PA. In the present opinion, the thresholds used for defining inactivity are those defined by the WHO (2010): 30 minutes of moderate intensity PA at least five times a week for adults and 60 min/day for children and adolescents.

Sedentariness is defined by a situation of wakefulness characterised by low energy expenditure (less than 1.6 METs²) in a sitting or recumbent position. Sedentariness (or sedentary behaviour) is therefore defined and considered distinctly from physical inactivity, with its own effects on health.

- **Characteristics of physical activity**

The different types of PA can be classified into five major categories depending on their intensity, estimated in METs:

- sedentary activities < 1.6 METs;
- 1.6 METs ≤ low-intensity activities < 3 METs;
- 3 METs ≤ moderate-intensity activities < 6 METs;
- 6 METs ≤ high-intensity activities < 9 METs;
- very high-intensity activities ≥ 9 METs.

Characterisation of PA can be supplemented by indications of duration (in minutes) and frequency (daily or several times a week).

The types of activities correspond to the physiological functions targeted: cardiorespiratory, muscular, flexibility and balance.

- **Definitions of populations considered**

Four age groups were selected:

- children, from birth to 10 years;
- teenagers, from 11 to 17 years;
- adults, from 18 to 65 years;
- people over the age of 65.

Certain population categories were the focus of particular attention:

- among children: the population of pre-school children (under 3 years), children enrolled in nursery school (3 to 5 years) and in primary school (6 to 10 years);
- among adults: women of childbearing age, women during pregnancy, breastfeeding or post-partum and women from menopause age;
- individuals reporting a functional limitation of activity (FLA) due to their state of health. People with difficulty mobilising basic physical, sensory or cognitive functions are hereinafter referred to as FLA individuals. The frequency of these functional limitations increases with age. They concern

² Metabolic Equivalent of Task: unit defined as the ratio of energy expenditure during the task in question to resting energy expenditure

less than 5% of the population under the age of 40 and affect 70% of men and 80% of women over the age of 85.

- **Tools for describing physical activity and sedentarity**

The tools used in publications and epidemiological studies (observational and interventional) were identified, making it possible to describe and quantify PA and sedentarity in order to offer a critical analysis of their relevance, robustness and limitations. The methods most frequently used in the studies are based on declarative data (collected by questionnaire) and, more rarely, on objective measurements of PA from dedicated, validated devices (pedometer, accelerometer, heart rate monitor). The lack of uniformity in the methods and their implementation in the published work hampers any comparison of these studies.

The declarative methods relating to PA have the advantage of simplicity, moderate cost and the coverage of a large part of the population. Their disadvantage is that they rely on heterogeneous survey protocols, about which there is a lack of consensus, and which have evolved considerably in recent decades, making comparisons over time difficult. In addition, they cannot be used with relevance for certain population categories, particularly among FLA individuals.

The most accurate and fairest approach to the practice of physical activity is based on a combination of objective methods (using dedicated equipment and materials) and declarative methods. These strategies however increase the cost of the studies. They nevertheless have the advantage that they can reduce declaration bias.

Concerning sedentarity, the time spent sitting in front of a screen (TV, video, video games and computer) is currently the most commonly used indicator in studies. However, this only accounts for part of the actual sedentarity time, which also includes time spent sitting or lying down in other situations.

To respond to the questions set out in the framing of the formal request, the Working Group began by describing behaviours in the population relating to PA and sedentarity, and then identified the factors associated with these behaviours. The effects of PA and sedentarity on health were then studied as well as the relationships between PA, sedentarity and sleep. Lastly, the risks associated with the practice of PA were characterised.

- **State of knowledge on population behaviour regarding physical activity and sedentarity**

Surveys carried out at the national level were considered, in particular the French Individual Survey on Food Consumption (INCA 2, AFSSA, 2009), the National Survey of Nutrition and Health (ENNS, InVS, 2007) and the Health Barometer (INPES, 2008).

Physical activity

Recent studies aim to account for the reality of PA practices (including time spent in leisure, transport, activity in the workplace or in the home) whereas previously, surveys were primarily interested in leisure and sporting activities. Their recent nature and their limited number mean, however, that it is not possible to measure trends over time or the possible effect of any recommendations.

These studies show that less than 37% of adults and less than 32% of people over the age of 65 are sufficiently active³. Concerning PA in women during pregnancy or post-partum, the French data are insufficient for drawing any conclusions. Less than 34% of children under the age of 11 engage in daily PA, and less than 50% of children play games outdoors on a daily basis. 12% of adolescents aged 11 to 14 years engage in 60 min of daily PA of at least moderate intensity; 43% of adolescents aged 15 to 17 years engage in at least 30 minutes of PA of moderate to high intensity.

In the current state of available knowledge, irrespective of the age groups, the PA of the population is therefore considered insufficient in light of the international recommendations (WHO, 2010).

Sedentarity

The available studies are unable to account for total sedentary time because they generally only report the time spent sitting in front of a screen. Nor do these studies specify the length of consecutive time spent in sedentary behaviour. Depending on the studies, adults spend between 3h20 and 4h40 daily in front of a screen, outside of working time. In studies also taking working time into account, it is estimated that adults spend at least 5 hours a day in sedentary activities; to our knowledge, there are no French data on women during pregnancy or post-partum. Young people aged between 3 and 17 years spend more than 2 hours daily sitting in front of a screen. For people over the age of 65, the time spent sitting in sedentary activities, including the time spent in front of a screen, is in excess of 3 hours a day.

Among FLA individuals, the few data available indicate that they practice as little as only half the PA of people without limitations. The time spent sitting is higher, mainly because of more numerous sedentary leisure activities.

■ **Factors associated with the practice of physical activity and sedentary behaviour**

The practice of PA and sedentary behaviour is influenced by many complex interacting factors. Identifying and understanding the factors associated with the practice of PA and sedentarity are of major importance for developing and improving public health interventions aimed at promoting PA or reducing sedentarity.

The identification of the factors associated with the practice of PA drew on a review of the literature by Bauman *et al.* (2012) (cross-sectional and longitudinal studies). According to the authors of this analysis, the main factors positively associated with PA are the following:

- demographic: young age (within each age population considered), male gender, good state of health and high level of education;
- psychosocial: high level of self-efficacy and perceived physical competence, positive self-image and enjoyment practising PA;
- behavioural: history of practising PA;
- environmental:

³ In reference to the current WHO recommendations

- related to the physical environment: high walkability of the neighbourhood, connectivity of streets, proximity of non-residential destinations (shops, places of recreation), accessibility of sports facilities, high population density, traffic safety, ease of use of public transport;

- related to the social environment: social support.

The main factors associated with physical inactivity are overweight, lack of time and perceived obstacles to PA. For children, insecurity in the neighbourhood as perceived by parents and children, especially by girls, is also a factor associated with physical inactivity.

The main factors associated with sedentarity are ageing and overweight. For adults, additional factors are unemployment, low level of education and depressive symptoms. For children, additional factors relate to the family context (such as the mother's level of education and the family's income, the number of screens per household and the existence of associated rules) and to the environment (such as the fact that the school is located in a priority education zone).

Besides the study by Bauman et al. (2012), the relationships between the factors mentioned above and PA and sedentarity were not all analysed exhaustively, mainly because most of the studies were carried out in countries outside the European continent (Canada, USA, Australia). This raises the question of the transferability of findings to the French context.

■ **Effects of physical activity and sedentarity on certain diseases**

The analysis of the relationships between PA, sedentarity and health drew on the INSERM collective expert appraisal (2008), supplemented by an update of the literature (up to 2014, inclusive). The data taken into account focus on the prevention of general mortality and morbidity related to cardiovascular diseases, type 2 diabetes, obesity, cancers (breast cancer and colorectal cancer in particular), respiratory diseases, bone and joint diseases, neurodegenerative diseases, autoimmune diseases and mental health, as well as quality of life. The conclusions of the report of the WCRF⁴ (2007) and its updates were also considered in the analysis of relationships between cancers and PA and sedentarity when these data were available.

General mortality: according to the studies, regular PA is associated with a 29 to 41% reduction in early mortality. It was calculated that daily practice of 15 min could already reduce the risk by 14%. Moderate to high-intensity PA in the general population may mitigate the effects of sedentarity on early mortality, especially in subjects whose sedentary time is more than 7 hours daily.

Type 2 diabetes: PA, associated with other health and dietary measures, is a major factor in preventing or delaying the onset of type 2 diabetes. In insulin-resistant subjects, PA is associated with a significant improvement in glucose tolerance. This effect persists after cessation of the activity (for up to 3 years). The beneficial effects of PA have been observed regardless of the Body Mass Index (BMI). Independently of the practice of PA, sedentarity is a risk factor for developing type 2 diabetes (more than 14% for 2 hours spent daily in front of the television). Conversely, a reduction in weekly sedentary time is associated with a decrease in the incidence of type 2 diabetes (decrease of 12% for a reduction of 2 hours per week).

⁴ World Cancer Research Fund

Obesity: regular PA reduces the risk of overweight, obesity and cardiometabolic complications. Multimodal interventions are most effective. Conversely, physical inactivity and sedentarity are associated with the risk of overweight, obesity and cardiometabolic complications.

Cardiovascular diseases: regular PA, of moderate or high intensity, is associated with a decrease of 20 to 50% in the risk of coronary disease and of nearly 60% in the risk of occurrence of stroke. Sedentary time is associated with an increase in the incidence of cardiovascular diseases. People spending more than 7 hours a day in a sitting position in front of a television screen have a higher risk of cardiovascular mortality (around 85%) than that of people who spend less than 1 hour a day in a sitting position in front of the television. Engaging in PA of moderate intensity cannot reduce the effects of sedentarity on the incidence of cardiovascular diseases.

Cancer: PA is associated with a decrease in the risk of colon cancer (of the order of 25%), breast cancer (10 to 27% decrease), endometrial and lung cancer. The onset of many cancers has been attributed to physical inactivity. Recent studies have shown an association between sedentarity and the risk of some cancers (endometrial, in particular). Sedentarity has an indirect effect by promoting obesity and abdominal obesity, major risk factors in the initiation and development of breast and colon cancers.

Respiratory diseases: the effect of PA on primary prevention of respiratory diseases has been little studied. The only studies available concern prevention of the risk of chronic obstructive pulmonary disease. Regular PA (of moderate to high intensity) helps limit the alteration of functional markers regarded as precursors of chronic obstructive pulmonary disease. Sedentarity is associated with a more marked impairment of respiratory functionality in chronic obstructive pulmonary disease.

Bone and joint diseases: throughout life, the practice of impact PA (for example running and jumping) is associated with a smaller decrease in bone mass and a lower risk of osteoporotic fractures. High-intensity weight-bearing impact exercises (running and jumping) contribute to significantly increased bone mass.

In children and adolescents, the regular practice of impact PA may enable a significant increase in bone mass and bone mineral density (BMD), especially when PA is practised during pre-puberty and puberty.

In postmenopausal women, impact PA has a positive effect on BMD (in the spine, femoral neck and trochanter). A combination of impact and muscle-strengthening PA is necessary to decrease the number of fractures; these effects may also be found in older men. A negative association may exist between BMD and sedentary behaviour (according to studies in adults and adolescents).

Concerning the prevention of osteoarthritis, dynamic weight-bearing activities of moderate to high intensity, without significant impact, may have a positive effect on cartilage.

Neurodegenerative diseases: regular practice of PA is associated with a decrease in the incidence of Alzheimer's disease (up to 45%), with a dose-response relationship; regular practice may be associated with a decrease in the incidence of Parkinson's disease. Physical inactivity may increase the risk for these two pathologies. The effect of sedentarity on the risk of developing neurodegenerative diseases has been little studied and it is not possible to draw any conclusions from the data.

Autoimmune diseases: the possible effects of PA and sedentarity on pathologies of auto-immune origin have not been documented to date.

Mental health and quality of life: a benefit from regular practice has been reported for up to 90 minutes of daily PA of high intensity, and may reduce the risk of a state of psychological stress, and its main clinical consequences, states of anxiety and depression. Beyond that, lower quality of life scores were found, suggesting an inverted U dose-effect relationship.

It is not currently possible to conclude as to the effect of sedentarity on mental health and quality of life.

■ **Effects of physical activity and sedentarity for certain categories of the population**

Children and adolescents: PA appears to be an essential component of health. Regardless of BMI, regular PA has favourable effects on physical condition, body composition and bone health. It is associated with a decrease in cardiovascular risk factors (high blood pressure, insulin resistance, dyslipidaemia, metabolic syndrome, etc.). The practice of PA helps improve mental health by strengthening confidence and self-esteem, and reducing anxiety, stress and the risks of depression.

PA can also be regarded as a favourable factor for academic success.

The PA practised during childhood and adolescence may have a favourable effect on health in adulthood. Conversely, sedentarity has deleterious effects on different health factors in adulthood (physical condition, body composition and bone development).

Pregnant women: regular PA improves physical condition and venous return, and decreases lower back pain and weight gain during pregnancy, regardless of BMI. The practice of PA does not increase, and may even decrease, the risk of premature delivery and pre-eclampsia. PA seems to present a benefit in reducing the risk of gestational diabetes, if it is started in the year before pregnancy or early in pregnancy. Regular practice of PA improves well-being and quality of life and decreases depressive symptoms during pregnancy and in the post-partum period.

People over the age of 65: regular adapted PA is associated with a reduced risk of sarcopenia, an improvement in balance and a decrease in the risk of falling. Regular PA may promote osteogenesis, reduce fracture risk and limit cognitive decline. Ultimately, PA seems to contribute to maintaining autonomy in the elderly.

Sedentarity may promote bone demineralisation, increase the risk of osteoporotic fractures and accelerate cognitive decline.

FLA individuals: regular practice of PA contributes to the prevention of chronic diseases, and improves functional capacity and physical condition, self-esteem, self-perception and confidence in one's own abilities. These factors allow greater autonomy in daily life, promoting the feeling of well-being, quality of life and social participation. In FLA children, it is also an essential factor in growth and development, and an opportunity for facilitated social interaction. Regardless of the severity of the FLA, regular practice of adapted PA brings benefits without increasing the risk of deterioration of major functions, or aggravation of the primary disability or pathology.

■ Relationships between physical activity, sedentarity and sleep

From early childhood, sleep time is insufficient in France. In adolescence, sleep disorders are frequent and these increase with age. These sleep disorders can be explained mainly by the failure to respect individual sleep needs.

PA acts directly on sleep by increasing its quantity and quality, and improves the quality of diurnal wakefulness. Conversely, physical inactivity and a high sedentary time may reduce the quantity and quality of sleep and, as with sleep disorders, diminish the quality of vigilance. These effects have been documented in adults, postmenopausal women and people over the age of 65. These effects are assumed in children, adolescents and FLA individuals. Regardless of age and gender, PA acts directly on the amplitude and synchronisation of circadian rhythmicity. This contributes to the programming of consecutive phases of activity and rest.

PA is a sleep regulator and a moderating factor for the effects of psychological stress on health. Disruption of the circadian cycle, as well as sleep breaks and debts, appear to increase the risk of many chronic diseases, including metabolic diseases.

The protective role of PA with regard to the occurrence of chronic diseases (in particular obesity and type 2 diabetes) may therefore result from both direct and indirect effects, through the regulation of sleep and the effects of psychological stress on health.

The positive effects of PA on sleep appear from the introduction of PA, and become long-lasting when the practice becomes regular.

■ Risks associated with physical activity

Characterisation of the risks associated with the practice of PA is based on updated data from the INSERM collective expert appraisal (2008) with regard to trauma, cardiovascular (sudden death), addiction and hormonal disorder risks. Other risks have also been identified. They relate to risks associated with the practice of PA in polluted outdoor air⁴ in atmospheric conditions with high temperatures (summer period or hot climate).

Trauma risks: the rate (9% to 16% of reports of injury per year of practice) and severity of injuries are low. Personal factors related to age and level of expertise, and extrinsic factors linked to the characteristics of the ground, equipment and climatic conditions may explain their occurrence.

Risk of sudden death: the risk is low, and mainly observed when subjects with a history of inactive behaviour practice high-intensity sports.

Other risks: muscle cramps, heat exhaustion or heat stroke may be caused by the practice of intense PA in a hot climate. The practice in polluted outdoor air⁵ can particularly increase the health effects of pollutants (pulmonary, cardiovascular and systemic risks).

The risk of addiction to PA, on the basis of the findings of INSERM and some more recent studies, is considered to be negligible in the general population.

Recent studies on hormonal disorders that may be related to intense practice of PA were taken into account. These disorders, such as delayed puberty, disruption of the menstrual cycle,

⁵ With regard to microparticles in suspension (PM_{2.5} and PM₁₀), ozone and nitrogen dioxide (NO₂)

amenorrhoea, oestrogenic deficiency inducing bone loss, oligomenorrhoea or anovulation, are considered negligible when the energy budget is balanced.

Concerning the specific population categories studied:

Children and adolescents: the majority of injuries occurring in children and adolescents are minor and relate to falls and collisions. The highest rates of injuries were identified in the youngest children, boys and individuals with a low level of practice (when related to the time of practice).

Women during pregnancy: few adverse events have been observed during practice.

People over the age of 65: the risks of injury or trauma associated with PA in everyday activities are lower in people practising regular PA than in those not engaging in PA. The risks of injuries associated with PA seem no higher in people over the age of 65 than in younger people, except for certain types of PA particularly presenting a risk. However, with ageing, certain changes in blood pressure regulation, thermal regulation and the sensation of thirst can give rise to adverse effects.

FLA individuals: the risks are low when the PA is adapted to the person.

4. RECOMMENDATIONS OF THE CES AND THE WG

■ General principles

All the observations made on the basis of both the description of the practices of physical activity (PA) and sedentary behaviours of the population in France, and the effects of the risks of PA and sedentarity and the benefits specific to PA, lead the WG and the CES to recommend the adoption of an active lifestyle, by the entire population, regardless of the age of the person. The adoption of this lifestyle aims to improve the physical and mental health status of the population, prevent the development of certain diseases, promote harmonious child and adolescent development, increase quality of life and reduce certain effects related to ageing.

Considering that the adoption of an active lifestyle entails on the one hand an increase in the practice of PA, and on the other a reduction in sedentary time;

Considering that the promotion of PA and the fight against sedentarity require the identification and characterisation of the factors associated with PA and sedentarity, which may constitute brakes or levers, at the collective or individual level, and that these factors must be taken into consideration, whether they are demographic, psychosocial or behavioural, or related to the physical and social environment, in strategies for promoting PA and reducing sedentarity;

The WG and the CES are issuing the following recommendations.

In order to define the PA guidelines that follow, the quantities of PA used were those that seemed to correspond to the greatest relative benefit in terms of prevention of the health risk associated with the insufficiency of PA and the excess of sedentarity for a given population (according to the age category and the specific groups) when considering simultaneously the health statuses and diseases studied. These guidelines have been designed with the aim of enabling decision-makers to support and assess strategies for promoting PA and reducing sedentary behaviour by primarily targeting the population categories most at risk. These guidelines are defined according to a level of practice for which an inflection is observed in the PA dose-response relationship compared to the expected health effects. Any level of practice of PA, even if it is below the guidelines, is still associated with a benefit to health. Practising PA beyond the guidelines presented below may provide an additional health benefit, in preventing certain chronic diseases.

■ Recommendations by population category

PA should be practised gradually, whether during the course of a session or when resuming activity. This is expressed as a gradual increase in intensity on each occasion ("warming up") and as a gradual increase in the practice of PA (with regard to its duration, frequency and intensity), especially among the least active individuals.

More generally, the intensity should be adapted to individual characteristics and adjusted according to the physiological responses perceived by each individual (especially the increase in respiration, perspiration or perceived difficulty).

The practice of PA must be adapted to climatic conditions, especially in the case of intense heat (by adapting clothing and hours of practice and by ensuring adequate hydration) and outdoor air

pollution, as announced in information and alert bulletins. PA should be varied both in type and intensity.

- **Adults**
 - Physical activity

Thirty minutes of PA developing **cardiorespiratory capacity**, of moderate to high intensity (Table 1), should be practised at least 5 days a week, while avoiding 2 consecutive days without PA. In this context, short periods of high-intensity PA should be included.

Additional health benefits can be obtained with 45 to 60 min of practice.

For inactive, sedentary individuals wishing to practice regular high-intensity PA, a prior medical consultation is strongly advised.

These activities can be carried out during everyday activities or as part of a dedicated activity.

Table 1. Examples of PA targeting cardiorespiratory capacity according to the practice context and the intensity

Cardiorespiratory PA			
30 min of moderate to high intensity			
At least 5 days a week - avoiding 2 consecutive days without practice			
Intensity	Intensity indicators	Everyday activities	Leisure PA
Moderate	Moderate shortness of breath, conversation possible Moderate sweating WHO scale of intensity (5 to 6 out of 10) 55 to 70% of maxHR*	Walking at 5 - 6.5 km/h Climbing stairs slowly	Swimming Cycling at 15 km/h
High	Severe shortness of breath, conversation difficult Profuse sweating WHO scale of intensity (7 to 8 out of 10) 70 to 90% of maxHR*	Brisk walking faster than 6.5 km/h Climbing stairs quickly	Running at 8 - 9 km/h Cycling at 20 km/h

* Heart rate

This total daily time can be split into periods of 10 min or less, distributed throughout the day.

PA for cardiorespiratory purposes and that targeting the muscles more specifically can be combined in the same activity or carried out in the course of the same day.

In addition to the PA for cardiorespiratory purposes presented above, **muscle-strengthening** activities should also be practised. This PA for strengthening the muscles in the upper and lower limbs can be practised during everyday activities (going up and down stairs, carrying loads, etc.). Sessions devoted to physical exercise can also provide an opportunity for practising such PA (use of body weight or weighted bracelets, elastic bands, etc.).

PA practised during dedicated sessions should have the following characteristics:

- be performed once or twice a week with 1 or 2 days of recovery between two sessions;
- include 8 to 10 different exercises involving the upper and lower limbs, repeated 10 to 15 times per series; each series can be repeated 2 or 3 times;
- present a contraction intensity enabling the repetition of 10 to 15 movements without muscle pain, with a perceived difficulty not exceeding 5 to 6 on a scale of 0 to 10. This intensity should be adapted to individual characteristics.

Table 2. Examples of PA for muscle strengthening

PA for muscle strengthening		
Intensity indicators	Everyday activities	Leisure PA
Intensity enabling the repetition of movements without pain (perceived difficulty not exceeding 5 to 6 on a scale of 0 to 10)	Going up or down stairs, carrying shopping or loads, etc.	Use of body weight or weighted bracelets, calibrated elastic bands, etc.

Exercises for **flexibility and joint mobility** are recommended 2 or 3 times a week; they can be carried out by means of stretching. These exercises should be preceded by a muscle warm-up, should be maintained for 10 to 30 seconds and repeated 2 or 3 times. They should be limited by any sensation of discomfort or stiffness.

- Sedentarity

Regardless of the context (work, transport, domestic, leisure), adults are recommended to:

- reduce the total time daily spent in a sitting position, as far as possible;
- interrupt extended periods of time spent in a sitting or recumbent position, at least every 90 to 120 min, with PA such as walking for a few minutes (3 to 5), accompanied by muscle mobilisation movements.

- **Women during pregnancy or post-partum**

- Physical activity

During pregnancy

In the absence of medical contraindication, pregnant women are advised to start or maintain PA.

The following are recommended:

- PA targeting cardiorespiratory capacity, of moderate intensity, for at least 30 min/day, at least 3 times a week;
- muscle-strengthening exercises practised once or twice a week and repeated between 15 and 20 times.

In all cases, the priority should be the continuity and regularity rather than the intensity of PA; high-intensity PA should be avoided and moderate-intensity PA, adapted to the physical capabilities of each woman, is recommended. There is no upper time limit that should not be exceeded.

Women who are usually sedentary or inactive should begin with 15 min/day of continuous PA, with the aim of reaching 30 min/day of activity targeting cardiorespiratory function before the end of the first trimester of pregnancy.

Post-partum period

In the absence of medical contraindication, and in the absence of perineal lesions during delivery, most PA can be continued or resumed after the post-partum consultation. Specific precautions should be taken according to individual particularities, during pregnancy and post-partum.

- Sedentarity

The guidelines proposed for adults apply to women during pregnancy and post-partum.

- **Postmenopausal women**

- Physical activity

In light of the physiological situation of postmenopausal women, the guidelines for the adult population have been supplemented for this population. Postmenopausal women are therefore recommended to practice a total of:

- 30 minutes of cardiorespiratory PA, of moderate to high intensity, at least 5 days a week;
 - 15 to 30 minutes of impact cardiorespiratory PA a day;
 - muscle strengthening PA through everyday movements or specific exercises 3 times/week, practising exercises with high resistance on at least two of these occasions;
 - stretching at least 2 or 3 times/week.
- Sedentarity

The guidelines proposed for adults apply to postmenopausal women.

- **Children**

- Physical activity

For children under 5 years of age, at least 3 h/day of PA are recommended, or 15 min/h for 12 hours awake.

For children and adolescents aged 6 to 17 years, at least 60 min/day of PA, of moderate to high intensity, are recommended.

- Sedentarity

The following are recommended:

- limit the total daily duration of sedentary activities during the wakefulness period;

- limit the duration of each sedentary activity, to not exceed 1h continuously for children under 5 years of age and 2h for children aged 6-17 years.

In light of the positive influence of the family and close friends, the educational or social framework and associations in the practice of PA, awareness should be raised and efforts made to support the involvement of parents and family friends, the school or social environment and voluntary associations in implementing the recommendations on PA, with the aim of preventing chronic diseases, and fostering the psychomotor and personal development of children and adolescents. In particular this requires proposing and promoting active lifestyles among adults (parents, educators, etc.) who could then act as a relay with the children.

To achieve this in all contexts (school and home environment, transport and leisure), spontaneous PA should be encouraged, relying on play and enjoyment, PA in groups or among friends should be promoted, and a wide diversity of PA should be offered.

- **People over the age of 65**

- Physical activity

PA targeting **cardiorespiratory capacity** should be practised for at least 30 min/day, for cardiovascular PA of moderate intensity, or 15 min/day for high-intensity PA, or a combination of PA of moderate and high intensities, at least 5 times a week.

Muscle strengthening activities should be practised 2 or more days a week, preferably non-consecutive, with 8 to 10 exercises each repeated 8 to 12 times.

These exercises should require effort from the main muscle groups of the lower limbs, upper limbs and trunk of the body.

Balance exercises can be integrated into everyday or leisure activities, at least twice a week, preferably on non-consecutive days. A series of 5 to 10 exercises, lasting 10 to 30 seconds, should be repeated 3 to 5 times.

Flexibility exercises are recommended at least 2 days a week for at least 10 minutes. The exercises must require effort from the main muscle groups and be repeated 3 to 4 times each, while maintaining static stretching for 10 to 30 seconds.

They can be carried out during everyday activities or practised during a specific session.

- Sedentarity

The guidelines proposed for adults concerning sedentary behaviour apply to people over the age of 65.

In general, it should be noted that age must not be considered as a limiting factor, an active lifestyle can be adopted at any age.

Table 3. Examples of PA for the general population

Context	Cardiorespiratory PA	Muscle strengthening	Balance*	Flexibility
Domestic	Walking (brisk) Walking uphill Climbing stairs Housework (vacuuming, etc.) Gardening DIY	Walking (brisk) Walking uphill Climbing stairs (shopping, DIY) Gardening (digging, hoeing, etc.) Standing up from a sitting position Crouching Lifting and carrying heavy loads	Standing on one leg	Housework
Transport	Climbing stairs Getting on and off the bus, etc. Walking to local shops, etc.	Climbing stairs	Using a bike, scooter	
Leisure	Walking Swimming Cycling Rowing Running Aerobics or aquagym Golf Snowshoeing Dancing etc.	Cycling Dancing Swimming Aquagym or keep-fit Tai Chi Golf Exercises using body weight or a wall as a resistance point (sit-ups, resistance exercises, push-ups), with small accessories (elastic bands, weighted bracelets, dumbbells) or muscle strengthening equipment (rowing machine, exercise bicycle, etc.)	Cycling Dancing Petanque (French bowls) Golf Tai Chi Yoga Walking (backwards, sideways, on the heels, on tiptoes, etc.), walking following a line or an edge Postural and balance exercises using unstable supports (soft ground, moving platform), modified sensory conditions (in visual terms, or by varying the position of the head), movement incorporating changes in direction, overcoming an obstacle, moving in a limited space on the ground or with limited foot contact (tiptoes, on heels, etc.).	Tai Chi Golf Yoga Petanque (French bowls) Specific relaxation exercises (stretching)

* recommended for people over the age of 65

- **FLA individuals**

- Physical activity

As a whole, the recommendations for the general population remain valid for FLA individuals: 30 minutes of daily cardiorespiratory PA of moderate intensity distributed throughout the day, combined with muscle strengthening at least twice a week. This PA should be spread throughout the week and gradually integrated into the lifestyle.

Mainly because of the heterogeneity of the FLA population, the type, duration, frequency and intensity of PA should be adapted according to the characteristics of the disability or disease, and the physical condition of the person.

The guidelines established for children and adolescents in the general population are valid for FLA children and adolescents, with the same restrictions and precautions as those mentioned for adults. The durations of practice, often shorter than those recommended for the children from the general population, generally correspond to those recommended for adults.

Special attention should be paid to adjusting the intensity indicators to the characteristics of the person. In addition to taking into account the contraindications specific to the disability or disease, to the state of health and the clinical status, particular attention must be paid to the specific homeostatic responses.

With supervised practice, a high level of competence in supervision is required to guarantee the expected benefits and the safety of the person practising the activity, in line with their vulnerability.

- Sedentarity

The guidelines proposed for adults concerning sedentary behaviour apply to FLA individuals. Implementation of the guidelines is especially recommended in this category, which is generally more sedentary than the general population.

- **Recommendations relating to sleep for all population categories**

PA targeting cardiorespiratory capacity, of moderate to high intensity and involving moving around, is most effective for combating sleep disorders. This includes walking, running, swimming or cycling at a regular speed.

Regular practice spread throughout the week is recommended, favouring duration rather than intensity.

Because sleep disorders are more common in the elderly, the benefits of PA on sleep are relatively high in this category of the population.

To promote wakefulness during the day and sleep during the night, PA outdoors, exposed to daylight should be preferred.

The quality and quantity of sleep are promoted regardless of the time of the day during which PA is practised. The effect is however especially positive when PA is practised between 15:00 and 19:00. Nevertheless, to avoid the risk of delaying sleep, high-intensity PA should be avoided after 21:00.

Concerning sedentarity, in order to reduce sleep disorders, sedentary behaviour should be limited, especially in children, adolescents and the elderly, in whom the harmful effects of such behaviour on sleep have been clearly established.

■ Recommendations by sector

Preamble

Implementing the PA guidelines presented above encounters obstacles that need to be better identified and quantified for the effective promotion of PA and reduction of sedentarity, whether it relates to different population categories, at different geographical scales (e.g. the size of municipalities) and in different contexts (the workplace, transport, the domestic environment and leisure). The obstacles identified mainly concern town and country planning, modes of transport and organisation of working time and school time. In light of these obstacles, different approaches relating to lines of action and research were studied and are proposed here. In addition, it seems important to raise awareness, train and involve the professions concerned (especially architects, engineers, planners, teachers, health professions and PA professionals) in the promotion of PA and the fight against sedentarity.

Lastly, it appears necessary to better assess the outcomes of the actions put in place in order to be able to prioritise them in the framework of a public health policy.

These proposals highlight the need to further develop this work on different levels, such as scientific, political and economic.

• **Urban planning**

- develop the urban environment (on criteria of safety, accessibility, aesthetics and while improving its walkability and the presence of protected spaces for cycling) and the urban furniture, preserve or develop green spaces (installation of fixed outdoor exercise apparatus, with facilitating hours of access, for example);
- foster collective transport, walkability and intermodality;
- promote dedicated facilities (proximity, accessibility, safety, etc.);

• **Workplace and school environment**

- organise school or work time (hours, division of working time) and the work space to help increase PA (especially PA at work and PA for leisure) and reduce sedentarity (by promoting active breaks);
- provide places for practising PA;
- increase the time spent practising PA at school.

Specific recommendations by age group are proposed in the report's recommendations.

- **Health professionals**

These specific recommendations are addressed as much to physicians as to other health professionals (pharmacists and physiotherapists, for instance).

The information to be conveyed concerns:

- the benefits and risks of PA and sedentarity, in light of the emergence and increase in the incidence of chronic diseases, risk factors for these pathologies, quality of life and well-being;
- promotion of PA and reduction of sedentarity, for all population categories;
- formulation of advice on the practice of PA, adapted to the characteristics of the person (in particular advice on the need for a gradual approach, means of implementing and maintaining the practice, the objectives set, the associated risks).

- **Professionals in physical activity and sport**

- strengthen the training of professionals in knowledge of the health benefits of PA in primary prevention;
- strengthen the knowledge and skills of stakeholders in the different methods of PA and its effects on the components of health according to the population and in the context of motor and mental disabilities;
- introduce training contents on possible ways to change behaviour and adopt an active lifestyle;
- take into account the specificity of PA according to periods of life;
- consider the determinants and factors associated with PA to promote PA and encourage regular practice;
- raise awareness among people practising PA about the harm associated with sedentarity – which may not be fully compensated by the PA – and propose ways for them to reduce it.

■ Research recommendations

Taking into account the gaps in knowledge identified in the scientific literature, research subjects and methodological recommendations were suggested and are presented here.

- establish consensus-based reference methods in order to reduce the use of heterogeneous methods of estimating PA and sedentarity;
- implement a mechanism for collecting data on the practices of PA and sedentarity combining different measurement methods in order to describe these behaviours, their associated characteristics and their development;
- integrate a qualification and quantification of sedentary behaviour into all epidemiological studies on the relationships between PA and health;
- study the mechanisms of the harmful effects of sedentarity, in particular in the initiation and progression of pathological processes;
- conduct both fundamental and applied research on the relationships between the level of practice of PA and sedentary behaviour; assess the possible level of protection of PA with regard to the adverse effects of sedentarity for chronic diseases and ageing;
- better identify the risks of the practice of PA, in particular the conditions for reducing the risks associated with outdoor air pollution when practising PA;
- conduct studies to assess the practice of PA and sedentary behaviour in the French overseas territories (DROM-COM)⁶.

● Women during pregnancy and post-partum

Studies are needed to determine:

- the effects of sedentarity during pregnancy on the health of the woman and the foetus;
- the effects of PA in the year before pregnancy;
- the effects of PA during pregnancy on the foetus but also on the health consequences in childhood and adulthood;
- the specificities related to the post-partum resumption of PA, depending on the type of delivery, both in the case of vaginal delivery with or without episiotomy, and caesarean section.

● Postmenopausal women

Studies are needed to confirm that the gain in bone mineral density associated with PA is actually reflected in a decrease in the risk of fractures as a result of the PA.

⁶ Départements et régions d'outre-mer et collectivités d'outre-mer (DROM-COM)

- **Children and adolescents**

- develop observational, experimental and interventional studies on the effects of PA on health factors and on the consequences of sedentarity; more specifically among adolescents, understand the effects of the level of PA and of the physical condition, and their interaction on health;
- identify the factors associated with the practice of PA and sedentary behaviour, and model the relationships between these factors;
- understand the mechanisms explaining the reduction in PA from childhood and adolescence, and the durability of behaviour from early childhood to adulthood; identify and target groups of children at high risk of early decline in PA;
- test approaches aimed at increasing PA and decreasing sedentarity in the different living environments of children aged 0 to 10 years;
- initiate studies enabling a joint analysis of PA and sedentary behaviours. In particular this involves better understanding and defining the duration of sedentary periods at the end of which a break in sedentarity would become necessary from the age of 6 years;
- study the mechanisms and links between PA, sedentarity, sleep and nutritional factors from the age of 6 years;
- assess the impact of changes in school rhythms on the practice of PA and sedentarity from the age of 6 years.

- **People over the age of 65**

- develop specific surveys on the practices of PA in the older population, in particular the very elderly;
- develop the data on sedentarity, quantifying and describing sedentarity (types and contexts);
- study the cellular mechanisms of PA that can reduce the risk of neurodegenerative disease;
- study the interactions of PA and sedentarity behaviour in elderly people.

- **FLA individuals**

- develop studies to assess PA and identify specific guidelines on PA for FLA individuals;
- identify the interactions between PA, sedentarity and health;
- conduct further study into the level of PA in specific groups, and the determinants and factors associated with the practice of PA;
- develop research on the mechanisms linking inactivity and sedentarity to risk factors for health in this population;

- develop and test approaches aimed at increasing PA and decreasing sedentarity within this population.

- **Sleep**

Priority should be given to conducting studies to quantify both the PA practised and the quality and quantity of sleep. The following are also recommended:

- analyse the relationships between sleep and sedentarity;
- identify the relationships between PA, sleep and health;
- identify the environmental factors (such as exposure to light) that have an effect on the relationship between sleep and PA;
- study the relationships between psychological stress, sleep and PA;
- study the variations in the relationship between sleep and PA, according to age;
- design questionnaires specific to children and adolescents.

5. AGENCY CONCLUSIONS AND RECOMMENDATIONS

ANSES adopts the conclusions and recommendations of the Working Group and the CES on Human Nutrition.

On completion of this work, ANSES believes that the scientific data are sufficiently robust to consider carefully the favourable effects of physical activity (PA) in preventing chronic diseases and improving the quality and quantity of sleep.

Beyond the still widespread idea according to which the benefits of PA are limited to the effects of the increase in energy expenditure, it should be considered that the short, medium and long term benefits are reflected in systemic, hormonal and metabolic effects, with broad preventive effects that can be observed on all the components of health, at the physical, mental and social level as defined by the WHO (1946).

In its more common usage, PA is mistakenly considered to only cover the practice of sport. Because by definition it implies any movement of the body, this practice should be understood as being integrated in all social and individual activities: moving around, carrying a load, going up or down stairs, being active in the home, etc. For this reason, the findings and recommendations were made in an integrative way: PA must be thought of as any movement of the body in its environment. As such, the recommendations are directed to the entire population and are intended to be followed in all contexts, whether occupational, domestic, or transport or leisure related. The idea of a time exclusively devoted to PA is evolving towards the search for any opportunity to be active. This is why many recommendations targeting actions focused on the living environment (workplace, school environment, etc.) are addressed by sectors in order to build an environment conducive to movement – in both space and time.

Among the factors relating to the physical environment, walkability seems able to favourably influence behaviour. Other factors related to the physical environment need to be better documented as to their effect on PA, especially in connection with land use plans: connectivity of streets, proximity of non-residential destinations, accessibility and availability of facilities, population density, and traffic safety. Similarly, air quality and noise may affect behaviour; the study of these effects, whether or not in combination, is still in its infancy.

The evolution in the nature of the recommendations enabled by this work comes from the fact that they no longer refer exclusively to activity durations - quite often only considering a few types of PA - but are becoming more diverse both in the nature of the proposed activities integrated into daily life, and in reference to the intensity (short-duration but intense PA also has a health benefit), the plurality of opportunities (work on flexibility, strength, practised at home), the specificity of the populations considered (children, the elderly, individuals with a functional limitation of activity) with recommendations targeting each group.

This change also relates to the simultaneous taking into account of physical inactivity characterised by a lack of PA and sedentarity characterised by an extended sitting or recumbent position, a situation entailing cumulative exposure to health risks that are now well identified. Therefore, it is the concomitance of an increase in PA and a reduction in accumulated continuous sedentary time that will produce the greatest effects on health. It is important to emphasise this point.

The Agency recommends in particular, in all contexts of life (the workplace, school, home, leisure and transport) and at all stages of life:

- promoting the practice of PA, considering all the types of PA (cardiorespiratory, muscle strengthening, flexibility) and identifying all the opportunities for practice at all times of the day, it being understood that PA should not be limited to the practice of sport;
- encouraging the reduction of sedentary behaviour by reducing the total time spent sitting on a daily basis and by increasing the frequency of active breaks during extended sedentary time;
- promoting the social value of the practice of PA under all circumstances and times of life in society: workplace, school time, transport and travel, etc. and documenting social perceptions and representations of sedentarity.

The objective of these recommendations is to enable the adoption of an active lifestyle from a very young age, in a favourable environment, while reducing the situations of inequality observed in PA and inactivity.

In addition, ANSES recommends supporting actions regarding initial and continuous training and information for health professionals on the health effects of PA and sedentarity, and on monitoring methods. This will enable them to support their patients in assessing their PA practices and sedentary behaviour, as well as in changing their behaviour, by identifying the obstacles and constraints to practice in the various contexts of life (work, transport, domestic, leisure) by providing tailored advice (on the need for a gradual approach, means of practising these activities, objectives to be achieved, related risks, etc.).

ANSES particularly stresses the heterogeneity of the descriptive studies on the practice of PA and sedentary behaviour in people living in France. The INCA 3 Study should provide new information to better describe behaviour in the different contexts.

In parallel, an assessment of the actions aimed at promoting PA and reducing sedentarity on a regional scale, taking active mobility into account, is necessary in order to learn lessons, adapt proposals and facilitate the transposition of the most effective actions to the different geographical scales and areas. Lastly, it would be useful to develop socio-economic research on reductions in health expenditure generated by the regular practice of PA and the reduction of sedentary behaviour.

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KEYWORDS

Physical activity, sedentarity, nutritional guidelines, chronic diseases, sleep.