SITTING

SMOKING OF THE 21ST CENTURY

IPRNworld

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SMOKING OF THE 21ST CENTURY

ANCC Accredited NCPD Hours: 2 hrs

Target Audience: RN/APRN

NEED ASSESSMENT

Sedentary behaviour is a significant risk factor for obesity, diabetes, and cardiovascular disease (CVD), with high levels of sedentariness linked to increased all-cause and CVD-related mortality, independent of physical activity. It includes any activity during commuting, at work, at home, or leisure time that does not substantially elevate energy expenditure above resting levels, such as sitting, reclining, or lying down. A sedentary lifestyle is often defined as engaging in less than 30 minutes of moderate-intensity physical activity at least three days per week. Studies indicate that 51% to 68% of an adult's waking hours are spent in sedentary activities, including screen time, occupational sitting, and prolonged transportation. Despite its well-documented role in chronic disease, sedentary behaviour remains under-researched in populations disproportionately affected by CVD, highlighting the need for targeted interventions and public health strategies to mitigate its impact.

OBJECTIVES

- Understand the concept of a healthy lifestyle and a sedentary lifestyle
- Discuss the Epidemiology of Physical Inactivity and the prevalence of Sedentary Behaviour in pregnancy
- Discuss the Determinants of Sedentary Behaviour
- Discuss the impact of excess sedentary behaviour on overall health
- Describe the importance of intentions to limit sedentary behaviour as a habit
- Identify the cognitive effects of a sedentary lifestyle at the workplace
- Describe the association between frailty and sedentary behaviour
- Discuss the negative health outcomes of continuous sitting

GOAL

This article aims to comprehensively examine the adverse effects of a sedentary lifestyle on overall health, with a particular focus on its impact on cardiovascular health and associated mortality. By analysing the physiological, metabolic, and cognitive consequences of prolonged sedentary behaviour, this article seeks to highlight the critical need for lifestyle modifications and preventive strategies to mitigate health risks and improve long-term well-being.

INTRODUCTION

Cardiovascular disease (CVD) remains the **leading cause of death** in the United States, accounting for approximately **697,000 deaths annually** as of 2022. Beyond mortality, CVD imposes a significant burden on individuals, leading to **disability, reduced quality of life, and financial strain**. A substantial proportion of the U.S. population is affected by **CVD and its major risk factors**, including **hypertension, obesity, diabetes, and physical inactivity**. As of 2019, approximately **one-third of adults aged 20 years and older** were diagnosed with CVD, highlighting the widespread nature of this public health issue.

Emerging research has identified **prolonged sedentary behaviour as an independent risk factor for CVD**, distinct from physical inactivity. A study examining adults aged **18–74 years** found that prolonged sedentary time was associated with **decreased HDL-cholesterol, elevated diastolic blood pressure, increased triglycerides, impaired glucose metabolism (higher two-hour glucose levels), and increased fasting insulin**, all of which contribute to cardiovascular and metabolic dysfunction.

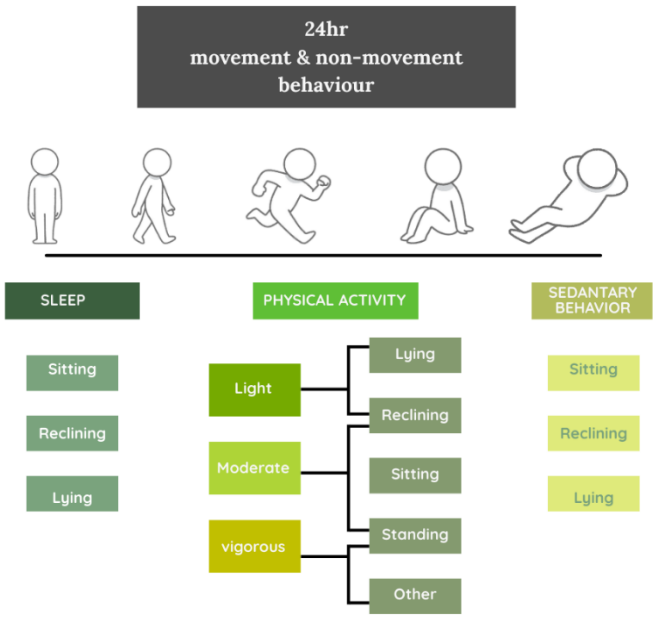
Although **physical activity and sedentary behaviour** are often viewed as **opposing behaviours**, researchers emphasize that sedentary time is not merely the absence of physical activity. An individual may meet the **recommended 150 minutes per week of moderate-to-vigorous physical activity (MVPA)** yet still engage in **excessive sedentary time at work, during commuting, or while engaging in leisure activities such as watching television or using a computer**. This highlights the need to address **sedentariness as a distinct health risk** rather than solely focusing on increasing physical activity levels.

The demographic patterns of sedentary behaviour are complex and influenced by **socioeconomic, occupational, and lifestyle factors**. Individuals in **higher-income or professional occupations** often spend prolonged periods sitting due to the nature of desk-based work, while those in **lower-wage jobs (e.g., food service, retail, or labour-intensive roles)** tend to have less occupational sitting time. However, research suggests that lower-income individuals may compensate

with **higher sedentary time outside of work** through activities such as **television watching and recreational screen time**. Age also plays a role—**younger adults (21–54 years)** often spend considerable time sitting at work and commuting, whereas **older adults (≥65 years)** tend to engage in high sedentary time due to **retirement, reduced mobility, and health-related limitations**.

Despite growing recognition of these trends, **research on sedentary behaviour and its demographic influences remains limited**. Understanding how **age, education, occupation, and socioeconomic status** shape sedentary habits is essential for designing **targeted public health interventions** aimed at reducing prolonged sitting and mitigating its detrimental effects on cardiovascular health.

LIFESTYLE AND ITS ROLE IN HEALTH PROMOTION



Lifestyle encompasses an individual's **patterns of interests, behaviours, and daily habits**, playing a crucial role in **health maintenance and disease prevention**. It is one of the most significant factors in **reducing premature mortality and improving overall well-being**. A **healthy lifestyle**, characterized by balanced nutrition, regular physical activity, and avoidance of harmful behaviours, is a key strategy in **minimizing the risk of noncommunicable diseases (NCDs)** such as cardiovascular disease, diabetes, and obesity. This article focuses on the impact of **physical inactivity—a key aspect of a sedentary lifestyle—on chronic degenerative diseases**, as well as the underlying **pathophysiological mechanisms** that contribute to these conditions.

Among the behaviours defining a **healthy lifestyle**, the most clinically significant is **engagement in regular physical activity**. Notably, **physical inactivity** is recognized as a **primary risk factor** for the development of NCDs. It is important to distinguish between **sedentary behaviour and physical inactivity**, as the terms are often used interchangeably despite their distinct definitions. **Sedentary behaviour** refers to prolonged engagement in **low-energy activities (≤1.5 metabolic equivalents [METs])** while sitting, reclining, or lying down. In contrast, **physical inactivity** is characterized by an **absence of sufficient**

physical activity to meet health guidelines. According to the **World Health Organization (WHO)**, adults should engage in **at least 150 minutes of moderate-intensity aerobic exercise per week** (e.g., cycling for 30 minutes, five times a week) or accumulate **at least 600 MET-minutes of activity weekly** to promote optimal health and reduce disease risk.

CONCEPT OF A SEDENTARY LIFESTYLE

A **sedentary lifestyle** is characterized by **waking behaviours** that involve **low energy expenditure (≤1.5 METs)** while sitting, reclining, or leaning. This definition, established by the **Sedentary Behaviour Research Network (2012)**, remains widely accepted. Common sedentary activities include **watching television, using a computer, playing video games, prolonged sitting at work or school, and commuting**.

According to the **2011 Compendium of Physical Activities**, **one MET** represents the **resting metabolic rate (RMR) of 1 kcal/kg/hour**, with physical activities classified as **sedentary (1.0–1.5 METs), light (1.6–2.9 METs), moderate (3.0–5.9 METs), and vigorous (≥6 METs)** based on intensity levels.

EPIDEMIOLOGY OF PHYSICAL INACTIVITY AND SEDENTARY BEHAVIOUR

Global Perspective

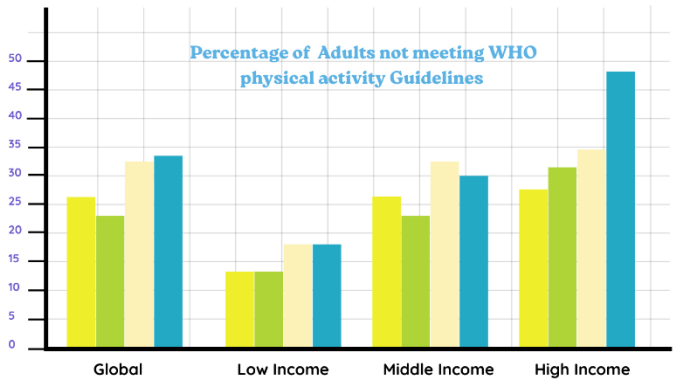
Physical inactivity is a significant public health concern worldwide. Approximately 31% of adults and 80% of adolescents globally do not meet the recommended levels of physical

activity, contributing to an increased risk of noncommunicable diseases and premature mortality.

United States

In the United States, physical inactivity remains prevalent. As of 2023, 24.2% of adults reported no physical activity or exercise outside of their regular job in the past 30 days. Sedentary behaviour is also widespread, with U.S. adults reporting an average of 9.5 hours per day engaged in sedentary activities, primarily during leisure and work-related domains. Notably, time spent in sedentary behaviour increased from an average of 5.7 hours per day in 2007–2008 to 6.4 hours per day in 2015–2016.

The high prevalence of physical inactivity and sedentary behaviour globally underscores the need for targeted public health interventions to promote active lifestyles and reduce sedentary time. Addressing these behaviours is crucial to mitigate the associated risks of chronic diseases and improve overall health outcomes.



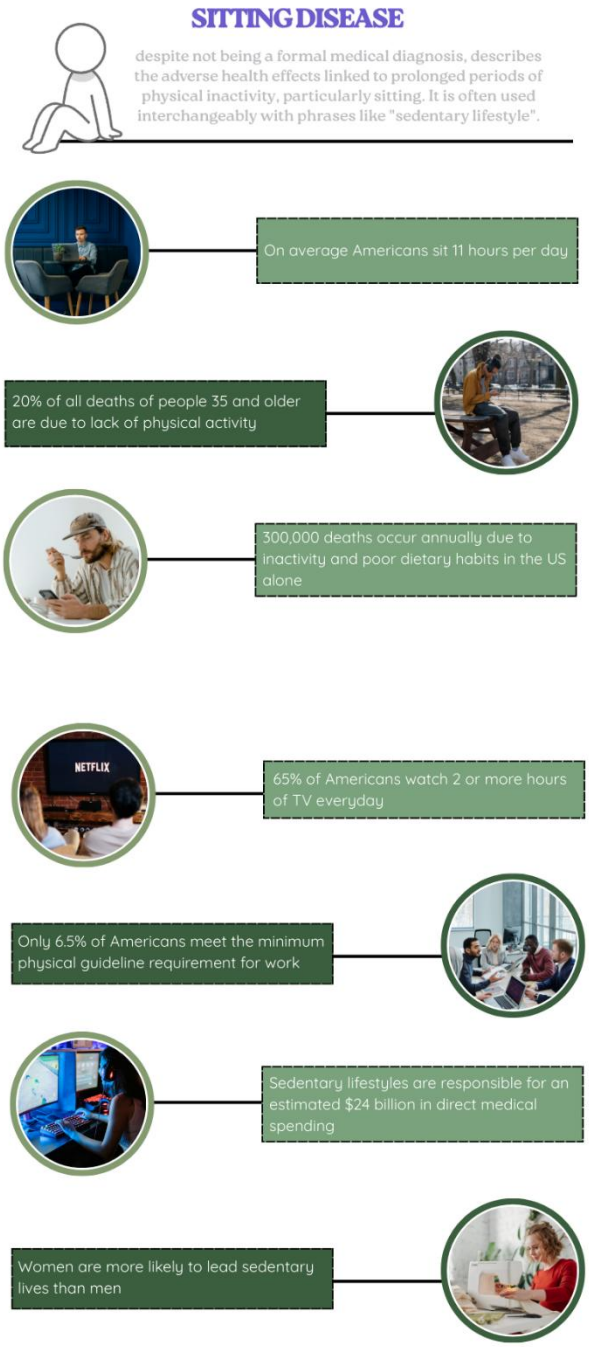
PREVALENCE AND HEALTH IMPLICATIONS OF SEDENTARY BEHAVIOR IN PREGNANCY

Sedentary behaviour refers to low-energy activities (≤1.5 METs) performed while sitting or lying down, with minimal energy expenditure. Epidemiological studies indicate that 55–60% of waking hours in the general adult population are spent in sedentary activities, a trend observed across all age groups in the United States.

Prolonged sedentary behaviour is a major risk factor for type 2 diabetes, cardiovascular disease, metabolic syndrome, and all-cause mortality. Recent evidence also highlights its adverse effects on mental well-being, including increased risk of depression. Notably, even individuals who meet physical activity guidelines remain at elevated risk of premature mortality and metabolic dysfunction if they engage in extended sedentary periods. In particular, sedentary activities such as prolonged television viewing have been strongly linked to obesity and type 2 diabetes, with studies suggesting that women may be more susceptible than men to these negative metabolic effects.

During pregnancy, excessive sedentary time may further contribute to cardiometabolic complications, including excessive gestational weight gain, gestational diabetes mellitus (GDM), and hypertension, as well as negative mental health outcomes. Given the potential

health risks for both mother and foetus, addressing sedentary behaviour during pregnancy is crucial for maternal and foetal well-being and should be a key focus in prenatal healthcare and public health initiatives.



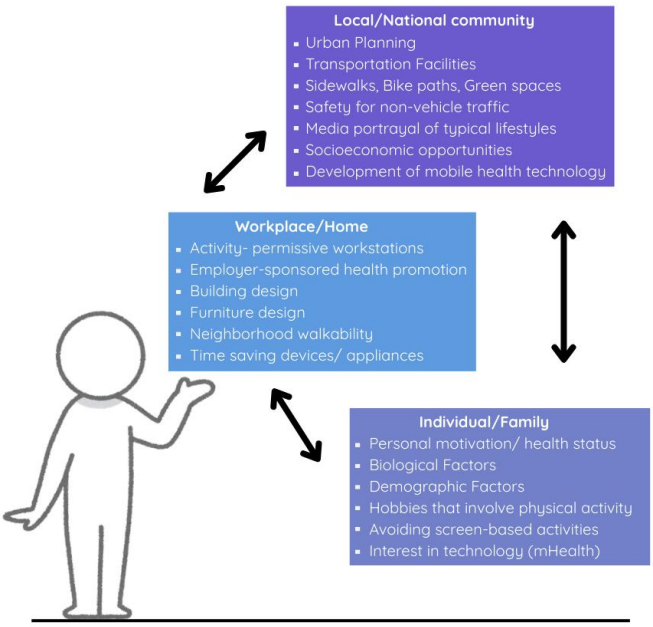
DETERMINANTS OF SEDENTARY BEHAVIOUR: GENETIC, ENVIRONMENTAL, AND SOCIOECONOMIC INFLUENCES

The Influence of Genetic and Environmental Factors on Sedentary Behaviour

Sedentary behaviour, defined as any waking activity with energy expenditure ≤1.5 METs while in a sitting, reclining, or lying posture, is a recognized contributor to premature mortality and chronic conditions such as type 2 diabetes and cardiovascular disease. Understanding the origins of individual variability in sedentary behaviour is essential for identifying effective intervention strategies. Both genetic and environmental factors play a role in shaping sedentary habits. Environmental influences, such as urban infrastructure, work-related demands, and transportation modes, significantly affect daily movement patterns. On the other hand, biological and genetic factors also contribute to intrinsic differences in sedentary tendencies. Evidence from twin and family studies supports the presence of familial aggregation, indicating that sedentary behaviour may have a heritable component.

By examining correlations among relatives, such as siblings, parents, and offspring, researchers can estimate the relative contributions of genetics and shared environments to sedentary lifestyles. Identifying biological pathways and genetic determinants linked to sedentary behaviour can

improve the design of personalized and population-level interventions, ultimately reducing time spent in inactivity and improving overall public health. [7, Rank 3]



Socioeconomic Determinants Associated with Sedentary Lifestyle

In recent years, **sedentary behaviour**—characterized by low-energy activities such as **sitting, reclining, watching TV, or using a computer**—has garnered increasing attention as a **distinct health risk**, independent of physical activity levels. Sedentary behaviour is strongly linked to **increased mortality and elevated risk for metabolic and cardiovascular diseases**, especially among **older adults**, who may spend up to **80% of their waking hours** in sedentary activities.

Identifying **socioeconomic and demographic determinants** of sedentary behaviour is critical to developing effective interventions, particularly for vulnerable populations. Evidence suggests that **midlife factors**, including **marital status, education level, housing type, weight status**, and **pre-existing heart disease**, are significantly associated with **higher sedentary time** in later life, even after controlling for confounding variables such as physical activity, BMI, and mobility limitations. For instance, **being unmarried, having only primary education, and living in duplexes or apartments** were associated with an **increase of over 12 minutes** of sedentary time per day.

Furthermore, longitudinal studies have shown that **age and lower educational attainment** are consistent predictors of sedentary behaviour over time. In addition, **increased body weight, BMI, fat mass, and waist circumference** have all been shown to forecast future increases in sedentary time. Interestingly, lifestyle factors such as **smoking** were associated with sedentary behaviour only in unadjusted analyses, and **occupational sitting time** was not significantly linked to sedentary behaviour in old age.

Importantly, **sedentary behaviour should not be viewed merely as the absence of moderate-to-vigorous physical activity (MVPA)**, but rather as a **distinct behaviour** with unique determinants and physiological impacts. Understanding these underlying factors is essential for informing **public health guidelines, clinical interventions**, and **prevention strategies**, especially as mounting

evidence continues to highlight the **serious health consequences of prolonged sedentariness**. [18, Rank 3]

THE IMPACT OF EXCESSIVE SEDENTARY BEHAVIOUR ON OVERALL HEALTH

Excessive sedentary behaviour has emerged as a major health threat. Although often confused with low levels of physical activity, sedentary behaviour is best defined as the amount of time that people spend sitting because most seated activities require minimal energy expenditure. National data indicate that American adults spend an average of 7.7 hours/day engaged in sedentary behaviour. Excessive sitting has been linked with increased risk for all-cause mortality and non-communicable diseases such as cancer, cardiovascular disease, and type 2 diabetes. These health risks are often independent of people's physical activity so reducing sedentary behaviour is an important public health goal in and of itself.

Although there have been many efforts to modify children's sedentary behaviour, we are only aware of a few, relatively recent efforts to reduce sedentary behaviour in adults. One barrier to effective intervention development may be the absence of basic research on the motivational processes underlying sedentary behaviour. [2, Rank 5]

The Impact of Sedentary Activities on the General Population

Sedentary behaviour encompasses any waking activities involving sitting, reclining, or lying down with an energy expenditure of ≤1.5 metabolic equivalents (METs). Some classifications also include passive standing activities (e.g., standing quietly, cooking, texting, or reading while standing), typically ≤2.0 METs. These activities are characterized by minimal energy use, close to the basal metabolic rate.

Estimates suggest that adults spend between 8 to 11 hours, or approximately 55% to 70% of their waking day, engaged in sedentary behaviour. Importantly, high levels of sedentary time are linked to various adverse health outcomes, independent of physical activity levels. This is particularly concerning given modern increases in sedentary behaviours, driven by advances in transportation, communication technologies, entertainment, and occupational demands.

Health Consequences of Sedentary Behaviour

Numerous studies have linked prolonged sedentary time to:

- **Obesity**
- **Type 2 diabetes**
- **Cardiovascular diseases**
- **Metabolic syndrome**
- **All-cause mortality**

Emerging research has also highlighted associations between sedentary behaviour and poor mental health outcomes, including depression and anxiety.

Context-Specific Risks

The health risks associated with sedentary behaviour may vary depending on the **context** (e.g., leisure vs. occupational) and **age group**:

- **Leisure-time sedentary behaviour**, such as prolonged television viewing, has strong associations with obesity and cardiometabolic diseases, especially in children and adolescents.
- **Occupational sedentary behaviour** shows mixed evidence. Some studies suggest that sedentary jobs do not significantly increase long-term health risks like hypertension or hypercholesterolemia. This may be due to low-level physical engagement in tasks such as typing, which may exceed the 1.5 MET threshold and offer minimal but beneficial energy expenditure.

Interrupting Sedentary Time: Physiological Benefits

Replacing sedentary time with light to moderate-intensity physical activities, such as slow walking or standing, has been shown to:

- Improve **insulin sensitivity**
- Lower **fasting triglycerides**, **total cholesterol**, and **non-HDL cholesterol**
- Increase **HDL cholesterol**, **apolipo-protein B**, and **non-esterified fatty acids**
- Improve **body composition** and reduce **visceral fat**

Even brief postural changes and interruptions in sitting time throughout the day can positively impact metabolic health and reduce disease risk.

Assessment of Sedentary Behaviour

To effectively monitor and reduce sedentary behaviour, accurate measurement is essential. Two primary approaches are used:

- **Subjective methods**:
  Self-report questionnaires, interviews, and activity diaries, which may overestimate activity levels.

- **Objective methods**:
  Devices such as accelerometers and inclinometers (worn on the waist, thigh, or wrist) provide more precise data on posture, movement, and energy expenditure.

Public Health Implications

Given the growing body of evidence linking sedentary behaviour to chronic disease and premature mortality, public health strategies are increasingly focused on:

- **Encouraging frequent movement breaks**
- **Promoting workplace modifications** (e.g., standing desks)
- **Raising awareness of the risks associated with prolonged sitting**, even in individuals who meet physical activity guidelines

Future recommendations should consider both **total sedentary time** and **context-specific activities** to better guide targeted interventions and health promotion efforts.

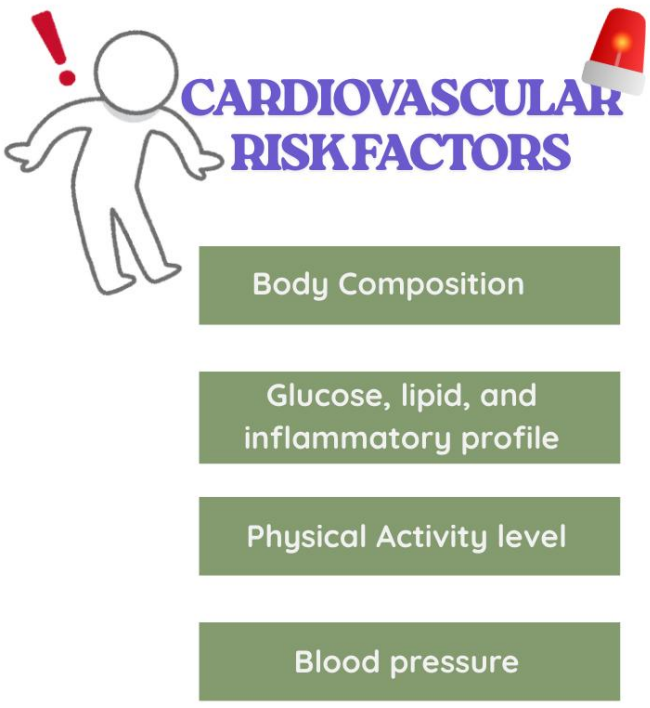
THE RELATIONSHIP BETWEEN SEDENTARY BEHAVIOUR AND HEALTH OUTCOMES

The relationship between sedentary behaviour and health outcomes may be of particular importance for individuals who are obese or overweight, as excess body weight is a risk factor for many of the same negative health outcomes as sedentariness. Obese individuals engage in approximately two more hours per day of sedentary behaviour compared to lean individuals, and sedentary behaviour occurs in longer bouts. Sedentary time is positively associated with waist circumference and weight gain from childhood to adulthood. In one study, overweight and obese adults had significant reductions in postprandial glucose and insulin when sedentary behaviour was interrupted by 2 min of light or moderate activity every 20 min. A better understanding of the relationship between total and prolonged sedentary behaviour and weight control may improve health outcomes for overweight and obese individuals. Sedentary behaviour has been identified as an important predictor of health outcomes. Recent research has observed positive associations between levels of sedentary time and risk of medical consequences, including diabetes, cardiovascular disease, and all-cause mortality, and these relationships persist when controlling for moderate-to-vigorous physical activity (MVPA) and body mass index (BMI). Sedentary behaviour may be particularly problematic when it occurs in prolonged periods. Independent of total sedentary time, evidence indicates that having fewer or shorter periods of sedentary behaviour is associated with lower BMI and decreased cardiometabolic risk factors. Additionally, experimental studies consistently find acute reductions in glucose and insulin when sedentary behaviour is

interrupted by any type of activity (e.g., standing) [5, Rank 3]

THE ASSOCIATION BETWEEN CARDIOMETABOLIC RISK MARKERS AND PHYSICAL ACTIVITY

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, representing a substantial public health burden. In the Americas alone, approximately 33% of all deaths in 2019 were attributed to CVD, with nearly two out of every five deaths among the elderly caused by these conditions. A heightened risk of CVD is frequently associated with adverse cardiometabolic indicators, including increased waist circumference, elevated blood pressure, and higher levels of low-density lipoprotein cholesterol (LDL-C).



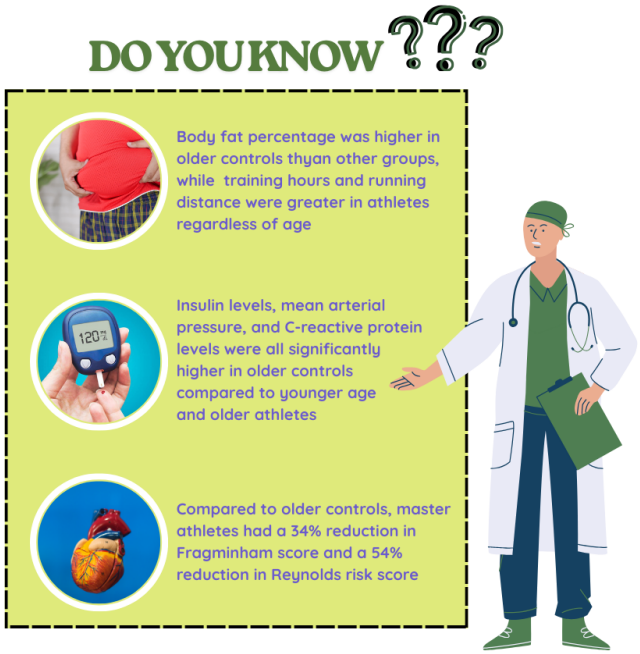
Emerging evidence suggests that these cardiometabolic risk markers can be mitigated through regular physical activity (PA) and reductions in sedentary behaviour (SB). Numerous studies have demonstrated that physically active adults exhibit more favourable cardiometabolic profiles, characterized by lower waist circumference, triglycerides, and LDL-C concentrations. However, findings in older adults remain inconsistent, potentially due to physiological differences, variation in activity patterns, and methodological limitations in research.

The protective effects of PA against CVD appear to be modulated by the intensity of the activity. Moderate-to-vigorous physical activity (MVPA) confers greater cardiovascular benefits than light physical activity (LPA). Nonetheless, a significant proportion of older adults—approximately 80%—do not meet the recommended levels of MVPA to attain optimal health benefits. While LPA is more commonly performed in this population, it remains understudied. Recent research in adults suggests that LPA may independently improve triglyceride levels, lipid metabolism, and insulin sensitivity, underscoring the need to examine its potential benefits among older individuals.

In contrast, the relationship between sedentary behaviour and cardiometabolic health in older adults is less clear. Sedentary behaviour—defined as any waking activity with an energy expenditure ≤1.5 metabolic equivalents

(METs) in a sitting, reclining, or lying posture—is prevalent in this age group, with many older adults spending over eight hours per day sedentary. However, findings regarding its impact on biomarkers such as HDL-C, triglycerides, blood pressure, glucose levels, and total cholesterol are mixed and inconclusive.

Moreover, older adults commonly exhibit both low levels of physical activity and high levels of sedentary behaviour, yet few studies have explored their combined effects on cardiometabolic risk. This evidence gap is further exacerbated by the limited use of objective tools, such as accelerometers and inclinometers, which are more reliable than self-reported measures. The reliance on subjective assessments may contribute to inconsistencies in the literature and underscores the need for more robust, objective data.



Given the aging global population and the increasing prevalence of CVD, further research is warranted to clarify the independent and joint effects of PA and SB on cardiometabolic health in older adults. Objective measurement and population-specific analyses are essential for informing targeted interventions and refining public health guidelines. [22, Rank 5]

THE ASSOCIATION OF SEDENTARY BEHAVIOUR WITH CARDIOMETABOLIC RISK IN CHILDREN

Sedentary behaviour has emerged as an independent risk factor for increased cardiometabolic risk in children and adolescents. Systematic reviews have consistently demonstrated associations between sedentary behaviours and reduced cardiorespiratory fitness, increased adiposity, and elevated risk of metabolic syndrome in the paediatric population. Notably, screen-based sedentary activities such as television viewing, computer use, and video gaming have shown stronger correlations with adverse health outcomes compared to total sedentary time measured objectively. These associations persist even after accounting for physical activity levels, suggesting that the behavioural context of sedentary time may be particularly influential.

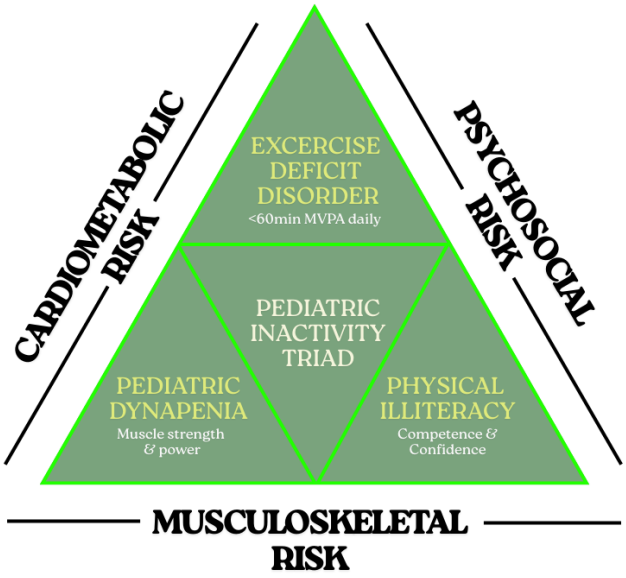
Although breaks in sedentary time have been linked to improved cardiometabolic profiles in adults, evidence in children remains limited and

inconsistent. Some studies indicate that frequent interruptions in sedentary time, particularly short bouts lasting 1–4 minutes, are associated with lower body mass index (BMI) and reduced cardiometabolic risk in children aged 8–11 years. However, larger-scale investigations have failed to replicate these findings consistently across broader paediatric age groups. For instance, one study among American youth aged 6–19 years found no significant relationship between breaks in sedentary time and continuous cardiometabolic risk markers, except lower waist circumference in boys aged 11–14 who accumulated breaks after 3:00 p.m.

Several physiological mechanisms have been proposed to explain these associations. In adults, prolonged sedentary behaviour has been shown to acutely impair insulin sensitivity and elevate triglyceride levels, likely due to reductions in lipoprotein lipase and glucose transporter activity in skeletal muscle. If similar metabolic responses occur in children, this may offer a plausible mechanism linking sedentary interruptions with improved cardiometabolic outcomes. Additionally, it is hypothesized that excess adiposity may predispose children to prolonged sedentary bouts and fewer activity breaks.

Importantly, the health risks associated with sedentary behaviour in children may depend more on the specific activities performed while sedentary, rather than the posture itself. For example, screen-based behaviours—particularly those involving exposure to food advertising—have been associated with increased caloric intake, contributing to weight gain and metabolic dysfunction. Conversely, passive sitting without cognitive or emotional stimulation appears to have minimal impact on energy intake or compensatory behaviour.

Emerging evidence suggests that measures of adiposity, such as BMI and waist circumference, are more consistently associated with sedentary behaviour than other cardiometabolic markers in children and youth. This may be attributable to the latency period required for obesity to manifest in overt cardiometabolic dysfunction. While only a small proportion of obese adolescents present with type 2 diabetes, a significant majority of youth with diabetes are overweight or obese, underscoring the pivotal role of excess body weight in disease progression.



In summary, sedentary behaviour—particularly

screen-based activities—plays a critical role in shaping cardiometabolic health in children and adolescents. However, further longitudinal and experimental studies are needed to clarify the causal pathways, identify vulnerable subgroups, and determine the relative contribution of specific sedentary modalities and patterns in this age group.

LACK OF PHYSICAL ACTIVITY AND ITS ROLE IN METABOLIC DISORDERS

Hyperuricemia, a condition characterized by elevated serum uric acid levels, has been implicated in oxidative stress-related pathologies, including gout and cardiovascular disease. According to data from the National Health and Nutrition Examination Survey, approximately 21.4% of adults are affected by hyperuricemia. The rising prevalence of this metabolic disorder has garnered significant attention, with contemporary lifestyle shifts, such as increased alcohol consumption, high-calorie diets, physical inactivity, and prolonged sedentary behaviour, emerging as key contributors to its incidence.

Given these trends, public health recommendations emphasize reducing sedentary time and promoting active lifestyles, particularly among the elderly, to mitigate disease risk and delay the aging process. Of particular concern is the strong association between metabolic syndromes and cardiovascular disease, a leading cause of morbidity and mortality worldwide. Prior studies indicate that a substantial proportion of the general population spends the majority of their waking hours engaging in sedentary behaviour. Consequently, sedentary lifestyles are estimated to contribute to approximately 9.4% of global mortality. These findings underscore the need not only to address physical inactivity but also to heighten awareness of the detrimental effects of excessive sedentary time.

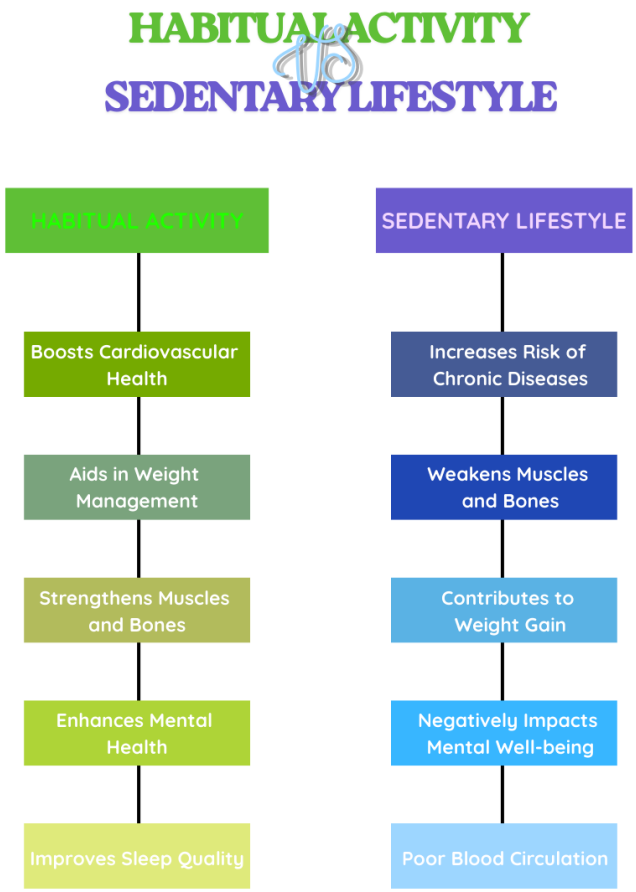
Historically, sedentary behaviour was classified under the broader category of "lack of physical activity." However, emerging research distinguishes these as separate yet interrelated risk factors, necessitating independent investigation into the effects of prolonged sedentary behaviour on metabolic health. Despite growing recognition of the role of sedentary lifestyles in modern metabolic disorders, limited research exists examining the relationship between hyperuricemia and physical activity, particularly in the context of gender and age differences. While prior studies have explored variations in hyperuricemia prevalence based on lifestyle patterns across demographic groups, there remains a paucity of research addressing the impact of sedentary behaviour and physical activity stratified by gender and age.

Moreover, obesity—a major risk factor for hyperuricemia—can be assessed using various

anthropometric and physiological measures, including body mass index (BMI, kg/m²), waist circumference as an indicator of central obesity, and bioelectrical impedance analysis. Given the distinct characteristics and implications of these measurement methods, further research is warranted to elucidate the independent associations between different obesity indicators and hyperuricemia. Expanding our understanding of these relationships will be instrumental in developing targeted prevention and intervention strategies for hyperuricemia and its associated metabolic disorders.

THE RELATIONSHIP BETWEEN SEDENTARY LIFESTYLE AND DIABETES

Diabetes affects nearly 20% of older adults (aged ≥65 years), with individuals over 75 years facing an even higher risk of complications, including hypoglycaemia, stroke, ischemic heart disease, and congestive heart failure. Given the projected doubling of the population aged 65 and older by 2056 and those aged 75 and older by 2034, identifying effective type 2 diabetes prevention strategies tailored to older adults is essential for improving public health. Approximately 90% of elderly-onset cases of type 2 diabetes are attributed to modifiable lifestyle factors, including physical inactivity and excess weight. Intensive lifestyle modifications, such as moderate-intensity physical activity and weight loss, have demonstrated strong efficacy in preventing type 2 diabetes in older adults. However, there remains a significant gap in understanding how to prevent diabetes in adults over 75 years, as achieving moderate-intensity activity may be challenging for this population.



Habitual activity activates AMPK and promotes glucose uptake in muscles, preserving insulin sensitivity, while chronic sedentary behaviour reduces AMPK activation, leading to insulin resistance, lipid accumulation, and metabolic dysfunction.

Targeting the lower end of the physical activity spectrum, specifically by addressing sedentary behaviour (i.e., prolonged sitting or lying with minimal energy expenditure), may offer a complementary strategy to traditional interventions. Older adults spend the majority

of their waking hours in sedentary activities, and research has linked excessive sedentary behaviour to elevated diabetes risk. The American Diabetes Association (ADA) recognizes the potential benefits of reducing and interrupting sedentary time in individuals with type 2 diabetes. However, the ADA also highlights the need for further research to determine whether reducing sedentary behaviour alone is an effective primary prevention strategy for diabetes in older adults. Although sedentary behaviour has been associated with type 2 diabetes, most studies focus on younger or middle-aged adults, with limited data on adults aged 75 and older. Additionally, the majority of existing research relies on self-reported sedentary time, which can be unreliable, particularly in older populations. Studies utilizing objective measures, such as accelerometers, to assess total sedentary time and patterns of accumulation in older adults are crucial for advancing our understanding of sedentary behaviour as a potential target for diabetes prevention.

A growing area of research involves assessing sedentary accumulation patterns, or how sedentary time is distributed throughout the day. For example, an individual who sits for 10 hours per day may accumulate that time in short bouts (e.g., thirty 20-minute periods) or long, uninterrupted bouts (e.g., ten 60-minute periods). Mounting evidence suggests that longer sedentary bouts have acute detrimental effects on glucose metabolism and cardiometabolic health, while frequent interruptions to prolonged sitting may mitigate some of these risks.

Prolonged sedentary accumulation patterns have been associated with increased metabolic disorder risk and higher mortality rates, suggesting that reducing extended sedentary periods could be a valuable strategy for preventing metabolic diseases such as type 2 diabetes. Understanding the importance of sedentary accumulation patterns will inform public health guidelines and recommendations for older adults, ensuring that sedentary behaviour reduction strategies become a central component of diabetes prevention efforts in later life.

THE COGNITIVE EFFECTS OF A SEDENTARY LIFESTYLE AT THE WORKPLACE

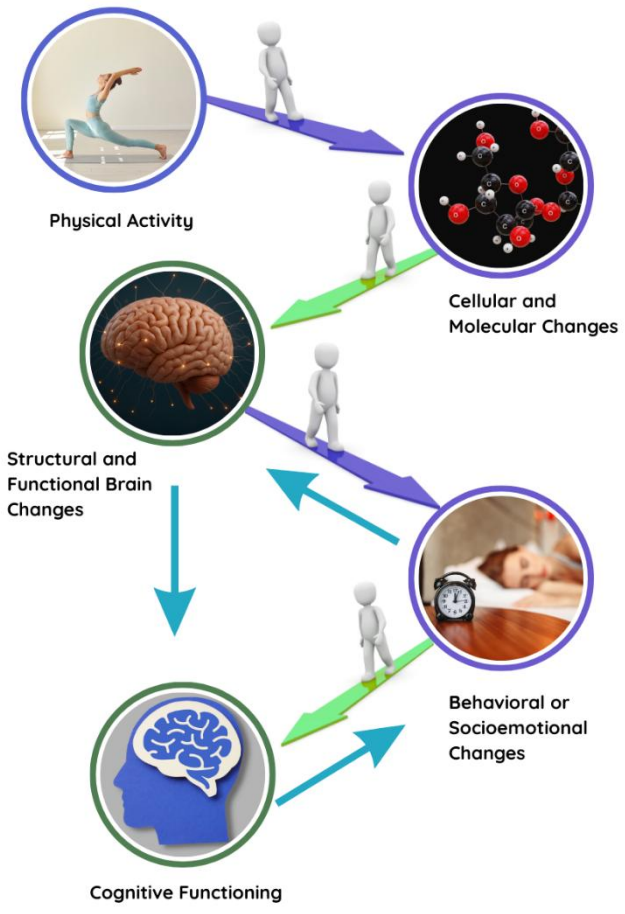
Humans' way of life has changed dramatically over the millennia. Originally a nomadic species, then hunter-gatherers, most humans are now fixed in one place for life. This physical anchorage is also found in daily behaviour. Humans have become sedentary. Among the distribution of activities in a typical day (excluding sleeping), the time spent at work is of the greatest significance. It is therefore particularly relevant to study the effects of sedentary behaviour at work, especially for

occupations that involve sitting at an office. Moreover, while the impact of sedentary behaviour on health is well established, its effects on cognition remain poorly understood

A sedentary lifestyle has become the default modern lifestyle in most societies. Currently, sedentary behaviour is defined by "any waking behaviour characterized by an energy expenditure ≤1.5 metabolic equivalent of task (METs), while in a sitting, reclining or lying posture". Nonetheless, stationary standing, which is often associated with an energy expenditure <1.5 METs, does not produce the same effects as prolonged sitting.

Indeed, sitting has negative effects on postprandial glycaemic metabolism, resulting in a decrease in lipoprotein lipase enzyme activity, which causes a reduction in triglyceride hydrolysis and a decreased glucose evacuation. On the other hand, standing allows a reduction of postprandial glucose and insulin; it is therefore sufficient to get up regularly (e.g., every 20 min) or to work standing to avoid these effects. Consequently, standing cannot be considered a sedentary behaviour even if it has been categorized as such in the past.

Strictly sedentary behaviours, including sitting, are recognized for their negative effects on health in the medium and long term. They increase the probability of developing type diabetes, cardiovascular diseases, musculoskeletal disorders (MSD), and even some cancers (breast, colon, colorectal, endometrial, epithelial ovarian). Although some of the deleterious effects of sedentary behaviours on physical health are becoming better understood, their psychological consequences are much less so, especially on cognitive functioning. Cognition can be defined as the operations of the human mind and the mental processes that process environmental information, reasoning, thinking, problem-solving, and decision-making. Yet, some data suggest that a sedentary lifestyle may have harmful consequences on cognition



Research has shown that body posture influences the mood of individuals [sad or

depressive patients tend to walk slowly and adopt a stooped posture]. More importantly, the amount of energy resources available to a body of an individual changes their perception of the world. Tired individuals perceive a hill as being steeper than tired individuals who have just consumed a sweet drink. The importance of the body in cognitive functioning is also evident in studies of physical activity.

Indeed, regular physical activity has a beneficial impact on cognition, mainly on executive functioning. Executive functions refer to high-level cognitive functions and control processes that occur when the usual courses of action are no longer relevant in a given context (i.e., new, unfamiliar, dangerous, or conflicting situations), thus allowing adaptation of the individual to new situations. Beneficial effects of physical activity are also reported on working memory tasks and information-processing speed tasks. These effects are also reported in normal aging, which suggests that physical activity may be a protective factor against aging, both in terms of physiological and cognitive functioning. [15, Rank 4]

Accordingly, studies on the effects of sedentary, outside the context of work have shown potential negative consequences. For instance, time spent watching television is associated with poorer episodic memory capacity (immediate and delayed recall), verbal fluency, executive functioning, working memory, cognitive inhibition, and information-processing speed over the long term. These results are extended to children and elderly adults. In addition, the amount of objective sedentary behaviours (as measured by the use of accelerometers) and cognitive abilities was found in a longitudinal study (over 2 years) in elderly adults.

However, the potential detrimental effects of sedentary behaviour on cognition are not always found. Moreover, it is important to take into account the type of sedentary activity, since time spent watching television and time spent reading (or listening to reading) cause different cognitive effects in young children. These correlational studies, outside the context of work, provide initial evidence in favour of the hypothesis that sedentary behaviour has a deleterious effect on cognition. Yet, these results are observed for long-term sedentary behaviours. It is thus impossible to make a causal link between the production of sedentary behaviours and cognitive alterations since many other lifestyle habits may be involved.

There is also no evidence that sedentary behavior could impact cognition in the short-term. As the consensual definition of a sedentary lifestyle is limited at a specific moment, it is very unlikely able to capture the potential deleterious consequences of a sedentary lifestyle on cognition. Indeed, in the field of physical activity, regular and prolonged activity is mandatory to observe beneficial effects on different cognitive domains. In the

same way, sedentarity may therefore have little effect on cognition at a specific moment, but only have significant consequences in the longer term.

It therefore appears important to distinguish the short term and the long term when the potential cognitive effects of a sedentary lifestyle are considered. It would then be particularly relevant to consider a definition of sedentarity that is not solely "physiological" and makes it possible to differentiate sedentary behavior from an individual, or from a sedentary lifestyle.

Several studies have been conducted in the context of work whereas sitting for a prolonged period at work is associated with an increased risk of mortality. Sedentariness might thus represent a major health issue at the workplace, especially in the service industry where workers may remain seated 9–11 h a day, and may also be a barrier to efficiency and productivity at work. Furthermore, the professional context is an environment in which it is easier to intervene to reduce sedentary behavior since a company can offer standing workstations at relatively low cost and encourage employees to get up regularly. [16, Rank 3]

Effects of work-related sedentarity on cognition appear mixed. Most of the studies do not report significant results on cognition, but other psychological consequences such as a decrease in the feeling of tiredness, an increase in motivation, and a more positive mood are nevertheless observed. The psychological repercussion of sedentariness may be better explored by considering sedentarity no longer through the physiological definition, but through a psychological definition referring to the prospective cognitive consequences of this way of life. It is also important to manipulate the production of sedentary behaviors instead of the practice of activities, as it was the case in most of the included studies.

Interventions to combat a sedentary lifestyle do not require a sporting activity, since simply standing can be enough to counteract the physiological effects of a sedentary lifestyle. This particularity makes it possible to intervene not only on the leisure time of an individual, but also on his or her time and place of work. It seems much simpler to suggest a person to get up regularly or to work while standing than to go for a 15-min run during a break. Health preventive programs may then propose work adaptation such as broadcast a signal to encourage the workers to get up every 20 min or suggest the use of standing desks or active workstations whenever possible. Finally, more information about the consequences of sedentarity on both physical and psychological health should be available to the workers and to the structures. [17, Rank 4]

THE ASSOCIATION BETWEEN SEDENTARY LIFESTYLE AND DEMENTIA

With improvements in living standards, human life expectancy has increased. However, dementia prevalence is also rising, primarily due to aging populations. Dementia is a complex neurodegenerative disorder with an **irreversible and progressive** course, contributing to significant cognitive and functional decline. It is currently one of the **leading causes of death worldwide**, ranking among the top five causes of mortality in older adults.

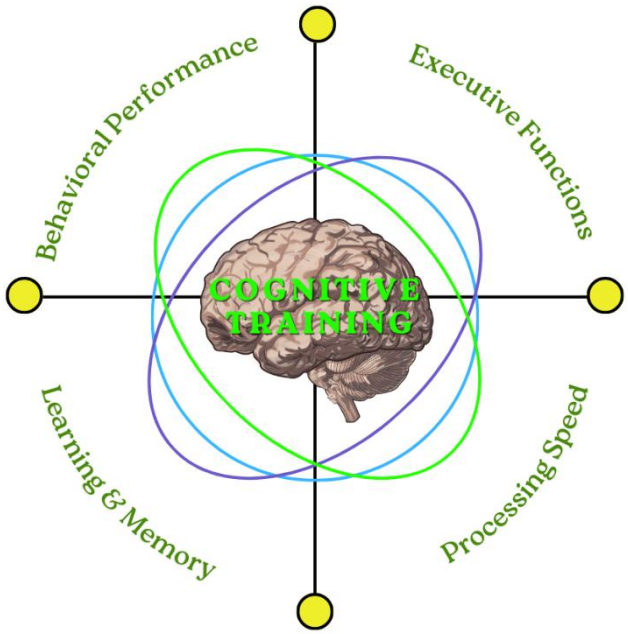
According to **Alzheimer's Disease International**, approximately **36 million people worldwide** currently experience dementia, with the incidence increasing at a rate of **one new case every seven seconds**. By **2030**, this number is projected to **reach 70 million** and **115 million by 2050**. While there is currently no cure, reducing modifiable risk factors, such as **physical inactivity**, may play a crucial role in prevention and management.

In recent years, there has been increasing interest in **physical exercise as a non-pharmacological intervention** for dementia. Regular physical activity has been shown to **support cognitive function** and may delay the onset of dementia in at-risk individuals. Conversely, a **sedentary lifestyle** has been identified as a **potential risk factor** for cognitive decline and dementia.

Sedentary Behaviour and Dementia Risk

With the rise of technology, many individuals engage in prolonged sedentary behaviours, such as **working at a desk, using mobile devices, and watching television**. This **decrease in physical movement** is particularly concerning for office workers, students, and individuals with limited mobility. Studies suggest that **prolonged sedentary behaviour is associated with lower cognitive performance**, although the extent to which it **directly increases dementia risk** is still under investigation.

Epidemiological research indicates that individuals who engage in prolonged sedentary behaviour may have a **20-30% increased risk** of developing dementia compared to those with more active lifestyles. However, it is important to note that sedentary behaviour often coexists with **other risk factors**, such as **poor diet, obesity, cardiovascular disease, and metabolic disorders**, which may contribute to cognitive decline.



Potential Mechanisms Linking Sedentary Lifestyle to Dementia

1. **Impaired Glucose and Lipid Metabolism**

- Prolonged sedentary behaviour is linked to **insulin resistance**, **poor glucose regulation**, and **dyslipidaemia**—all of which are associated with **cognitive impairment and increased dementia risk**.

2. **Chronic Inflammation**

- **Elevated inflammatory markers** (e.g., **C-reactive protein (CRP)** and **interleukin-6 (IL-6)**) have been observed in individuals with sedentary lifestyles. Chronic inflammation is a well-documented contributor to **neurodegenerative processes**.

3. **Reduced Brain Blood Flow and Neuroplasticity**

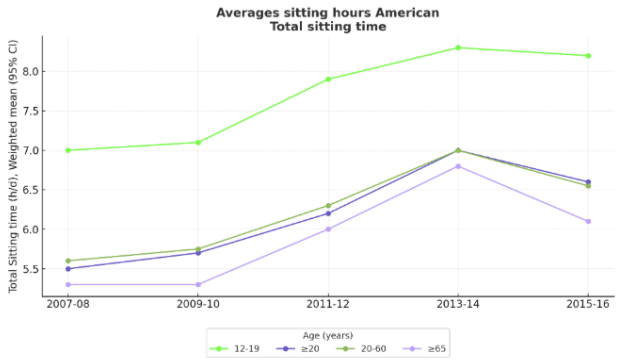
- **Physical activity promotes cerebral blood flow and neurogenesis**, whereas prolonged inactivity may reduce **oxygen and nutrient delivery to the brain**, accelerating cognitive decline.

4. **Loss of Protective Effects of Physical Activity**

- Exercise has been shown to **enhance synaptic plasticity**, **reduce amyloid-beta accumulation**, and **support memory-related brain structures** (e.g., hippocampus). A sedentary lifestyle may deprive the brain of these benefits, increasing dementia risk.

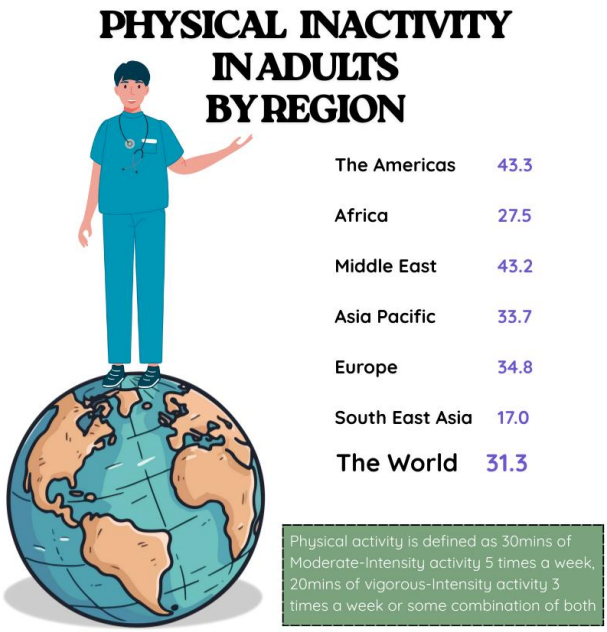
While **sedentary behaviour is increasingly recognized as a potential risk factor for dementia**, further **longitudinal and interventional studies** are needed to determine **causality**. Given that physical activity offers **protective benefits** for brain health, reducing sedentary time and incorporating **regular movement** into daily routines may be an important **preventative strategy** for dementia.

ASSOCIATION OF SEDENTARY LIFESTYLE WITH OVERALL MORTALITY

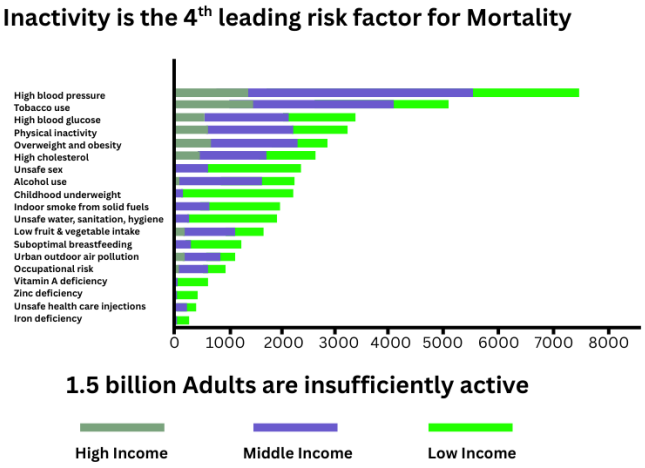


There is increasing evidence that sedentary behaviour, characterised as any waking behaviour with low energy expenditure while in a sitting or reclining posture, is strongly associated with several health outcomes. These studies have shown that high levels of sedentary behaviour are associated with a greater risk of morbidity and mortality, which is potentially concerning given that most adults spend the majority of their waking hours

engaging in this behaviour. In contrast, it is known that high levels of physical activity, particularly moderate-to-vigorous physical activity (MVPA), are associated with improved health, often in a dose–response manner. Sedentary behaviour and MVPA share a weak inverse relationship and it is possible for an individual, over a day, to have high levels of physical activity and still accumulate large amounts of sedentary time.



Previous research has largely focused on the independent associations of total physical activity, MVPA, light-intensity physical activity, and sedentary time on health. As a consequence, the daily equilibrium between physical activity and sedentary behaviour, and the pooled relationship they share with biomarkers of health, is not fully understood. Although some studies have started to explore different techniques for quantifying combined connections and patterns of MVPA and sedentary behaviour, only one study based in the USA has investigated the associations between categories of physical activity and sedentary time with markers of health.



It is found that in comparison to adults who engaged in <150 min/week of MVPA with high sedentary time (sedentary time > light-intensity physical activity time), participants engaging in ≥150 min/week of MVPA had a more favourable cardiometabolic health profile regardless of their sedentary status, suggesting that regular MVPA may offset some of the harmful consequences of a habitually sedentary lifestyle. If verified, this would be a clinically important message for a large proportion of the population who may be concerned about the amount of time they spend sitting. [14, Rank 3]

THE IMPORTANCE OF INTENTIONS IN REDUCING SEDENTARY BEHAVIOUR

Motivation and Habit Formation in Sedentary Behaviour

Motivation refers to the cognitive and emotional processes that initiate, direct, and sustain behaviour over time. Recent advances in motivation research emphasize dual-process theories, which distinguish between:

- Automatic processes (impulsive)—driven by habitual responses to environmental cues.
- Controlled processes (reflective)—involving deliberate decision-making and goal-setting.

The automatic regulation of sedentary behaviour plays a significant role in habit formation. When individuals frequently engage in sedentary activities in stable contexts (e.g., sitting while working or watching TV in a favourite chair), they form strong associations between context and behaviour. Over time, these behaviours become habitual, occurring automatically in response to cues. While habitual sedentary behaviour has been well-documented in children, research on habitual sedentary behaviour in adults remains limited.

The Role of Intentions in Reducing Sedentary Behaviour

Intentions (goals) are central to theories that emphasize controlled motivational processes. Unlike physical activity, which people may actively plan to engage in, few individuals intentionally plan to be sedentary. However, they may form intentions to reduce sedentary time.

Studies suggest that stronger intentions to limit sedentary behaviour are associated with reduced sitting time. Many interventions promote setting specific goals for reducing sedentary behaviour, such as:

- Limit continuous sitting to 30 minutes before taking a break.
- Setting personal daily movement goals to interrupt prolonged sedentary time.

Intentions related to sedentary behaviour can fluctuate over time, similar to intentions for physical activity. Thus, it is important to differentiate between:

- Between-person processes (e.g., individuals who habitually engage in less sedentary behaviour due to consistently strong intentions).
- Within-person processes (e.g., individuals engaging in less sedentary behaviour on days when their intentions to limit sitting are stronger than usual).

The Interaction of Habits and Intentions in Regulating Sedentary Behaviour

Although automatic (habitual) and controlled (intentional) processes regulate sedentary behaviour through different mechanisms, they are interconnected.

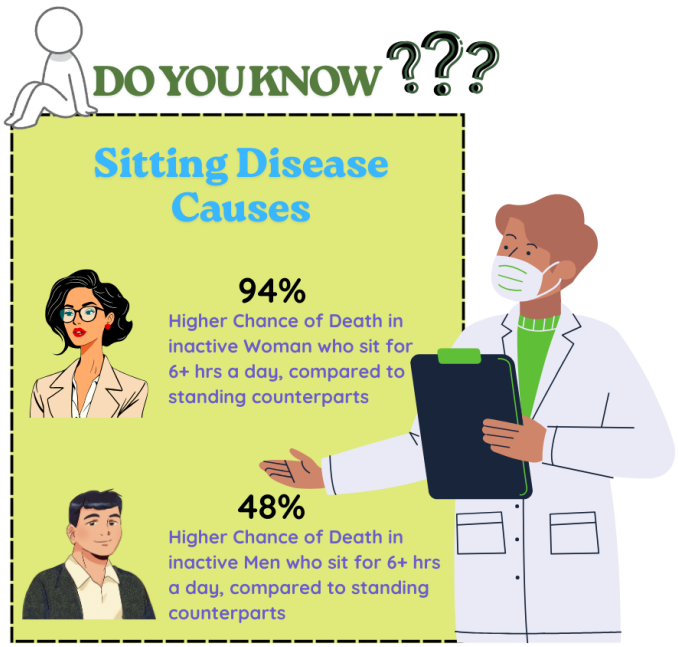
- Habitual sedentary behaviour occurs automatically when individuals encounter specific contextual cues (e.g., sitting at a desk).

- Intentional processes (e.g., goal-setting) can help interrupt habitual sedentary behaviour.

Studies have found that:

- People with stronger long-term intentions to limit sedentary behaviour tend to engage in less sedentary behaviour.
- On days when individuals have stronger intentions than usual, they are likely to sit less compared to their average behaviour.

These findings highlight that habit formation and intention-setting play distinct yet complementary roles in behavioural regulation.



The Importance of Physical Activity in Combating Sedentary Behaviour

Several factors influence both motivation and sedentary behaviour, which may complicate interpretations of sedentary behaviour research:

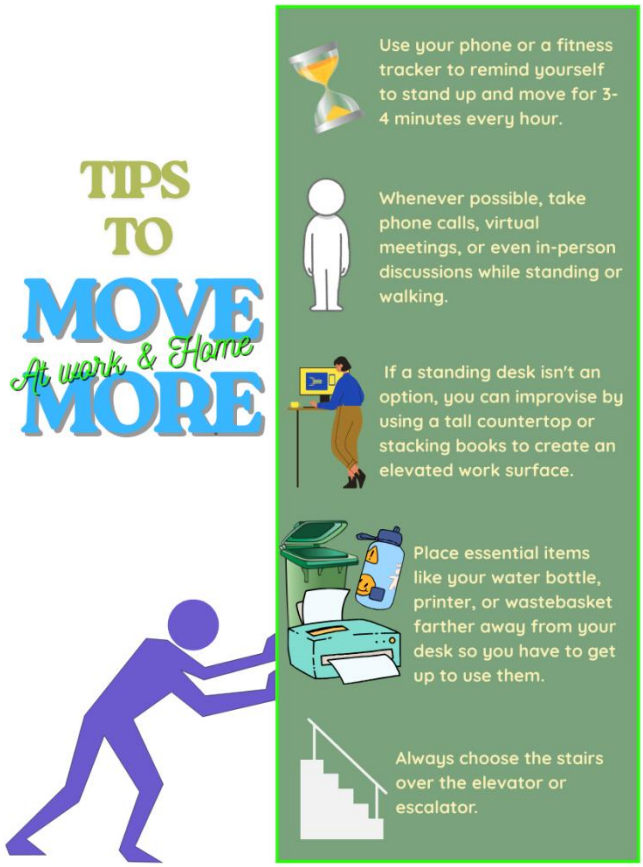
- Inverse relationship between physical activity and sedentary behaviour—Since sedentary behaviour and physical activity are inherently opposite behaviours, increasing daily physical activity should reduce sedentary time.
- Sedentary behaviour regulation—Some researchers propose that individuals may have a set-point for sedentary behaviour, meaning that reducing sedentary time on one day may lead to compensatory increases on another day.
- College students and working adults experience fluctuations in sedentary behaviour due to social schedules:
  - Higher PA and sedentary behaviour on weekdays compared to weekends due to structured routines.
  - Daily variations in class schedules, extracurricular activities, and work obligations influence movement patterns.
- Reactivity to self-monitoring—Studies using ecological momentary assessment (EMA) suggest that individuals may temporarily change their sedentary behaviour when they are aware they are being monitored.

Intentions to limit sedentary behaviour play a crucial role in reducing daily sitting time, but habits also exert a strong influence. Effective behaviour change strategies should incorporate:

- Goal-setting techniques (e.g., breaking up sitting every 30 minutes).

- Contextual modifications to disrupt sedentary habits (e.g., standing desks, walking meetings).
- Physical activity promotion to naturally displace sedentary behaviour.

Recognizing the complex interplay between automatic habits and intentional efforts can help design more effective interventions for reducing sedentary behaviour and preventing sedentary lifestyle-related diseases.



HOW ACADEMIC SKILLS ARE ASSOCIATED WITH PHYSICAL ACTIVITY AND SEDENTARY LIFESTYLE

In developed countries, **physical activity (PA) levels are declining**, particularly in **active transportation**, while **sedentary behaviours**—such as **watching TV, using computers, and playing video games**—are increasing among children. This trend is a **major public health concern**, as a sedentary lifestyle during childhood is associated with a **higher risk of chronic diseases in adulthood**.

Physical Activity and Academic Achievement

Research suggests a **positive association** between **higher levels of PA** and **better academic achievement** in children. Several **intervention studies** have provided evidence that incorporating **90 minutes of moderate-to-vigorous PA per week**, **60 minutes of physical education per day**, or **40 minutes of after-school PA per day** can improve academic outcomes. However, some studies have reported **weak or non-significant relationships**, suggesting that the association between PA and academic achievement **may depend on the type, duration, and intensity of PA**.

One possible explanation for these **inconsistent findings** is that **different types of PA** may have varying effects on **academic performance**. For example:

- **Organized sports** appear to be more **strongly associated** with academic success

compared to overall PA levels in adolescents.

- A **single 20-minute session of moderate-intensity PA** has been shown to **improve academic test performance** in children.
- Some forms of PA, such as **physically active school transportation (e.g., walking or biking to school)** and **recess PA**, have shown potential benefits for specific academic skills like **reading fluency and arithmetic performance**.

Cognitive Benefits of Physical Activity

Both **acute** and **long-term** PA interventions have demonstrated **cognitive benefits** that may underlie improvements in academic achievement. Studies indicate that PA enhances:

- **Attention, concentration, and working memory**—critical for learning and problem-solving.
- **Executive functions**, such as cognitive control and decision-making. For instance, a **9-month PA intervention** in 8–9-year-olds improved working memory, while a **13-week PA program** enhanced executive functions in overweight children.
- **On-task behaviour** in classrooms, particularly when PA is incorporated into **recess or school breaks**.

Sedentary Behaviour and Academic Performance

Most research on **sedentary behaviour** and **academic achievement** has focused on **screen-based activities** (e.g., TV watching, computer use, and video games). The findings are **mixed**:

- **TV watching** is often negatively associated with academic performance, but some studies suggest that **moderate TV viewing** may have a **neutral or even positive** effect on certain skills.
- **Having a TV in the bedroom** is consistently linked to **poorer academic achievement**.
- **Home computer access** has been associated with **better academic performance**, especially in younger children.

Gender Differences in PA, Sedentary Behaviour, and Academic Achievement

Research suggests that **boys and girls may experience different associations** between **PA, sedentary behaviour, and academic skills**:

- **Among boys**:
  - **Higher levels of total PA and active school transportation** are associated with **better reading fluency and comprehension**.
  - **Screen-based sedentary behaviour related to academic tasks (e.g., using a computer for learning)** is positively

linked to **better reading fluency and arithmetic skills**.

- **Video game playing** has been associated with **improved arithmetic performance**.

- **Among girls**:
  - **Total PA** has either a **weak inverse or no association** with academic skills.
  - **Screen-based sedentary behaviours related to music, arts, and crafts** are **negatively** associated with academic performance.

While evidence suggests that **PA has cognitive and academic benefits**, the relationship is complex and depends on **PA type, duration, and context**. Similarly, **sedentary behaviours** can have **both positive and negative effects** on academic performance, depending on **activity type and purpose**. Future research should **differentiate between various forms of PA and sedentary behaviour** to provide **more precise recommendations** for optimizing children's learning and cognitive development.

THE IMPACT OF BEHAVIOURAL WEIGHT LOSS TREATMENTS ON SEDENTARY LIFESTYLE

Activity recommendations in the context of behavioural weight loss (BWL) typically focus on increasing moderate-to-vigorous physical activity (MVPA). Given that waking time is divided among several activity levels (sedentary, light, moderate, and vigorous), increases in moderate-to-vigorous physical activity (MVPA) must be accounted for by decreases in other levels of activity. However, only a small number of studies have explored changes in sedentary behaviour and associations between those changes and changes in moderate-to-vigorous physical activity (MVPA) during behavioural weight loss (BWL). Preliminary studies suggest that individuals may experience modest, statistically significant decreases in sedentary behaviour over the course of treatment.

In one study, a greater decline in self-reported TV viewing (a proxy for sedentary time) was observed in individuals receiving behavioural weight loss (BWL) than in individuals receiving metformin, though no recommendations regarding sedentary behaviour were made. This decrease was associated with an increase in self-reported moderate-to-vigorous physical activity (MVPA). Another study using objective measurement of activity, which typically yields higher rates of sedentary time than self-report and is likely a better estimate of activity, found that a behavioural weight loss (BWL) program for overweight or obese adults (ages 18–35 years) produced small but significant decreases (12 min/day) in sedentary time.

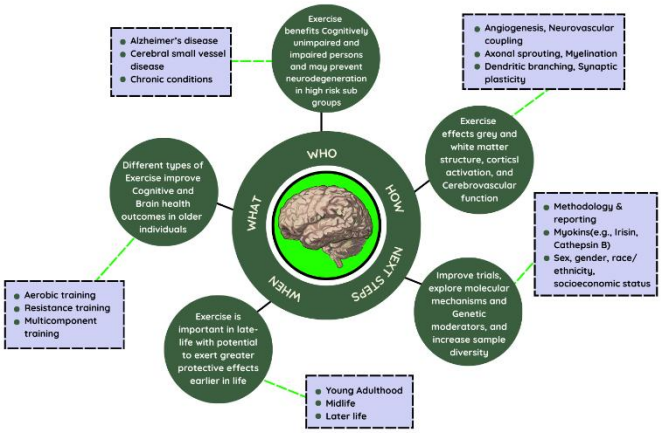
An even smaller number of studies has evaluated whether changes in sedentary behaviour relate to changes in weight in the context of a behavioural weight loss (BWL),

yielding mixed results. One study showed no relationship between changes in total sedentary time and changes in weight in the context of a behavioural weight loss BWL. Another study of obese older adults found that modifying typical BWL by focusing considerable attention on increasing light-intensity activity by interrupting sedentary time improved weight outcomes compared to BWL alone. [6, Rank 1]

THE FACTORS RELATED TO PHYSICAL ACTIVITY COMBINED WITH SEDENTARY LIFESTYLE AMONG ELDERLY

Population aging is a manifestation of the world order. It is estimated that by 2070, the portion of the elderly will correspond to 35% of the American population, which indicates the need for public health to turn to such projections. In general, the changes in physical, physiological, psychological, and social spheres related to aging can be easier if a more-active lifestyle is adopted. The recommendations of the World Health Organization (WHO) regarding care strategies to respond to the demands of the population aging in the world refer precisely to physical activity considering that physical inactivity is responsible for 9% of deaths worldwide, which means it is the fourth mortality risk factor.

Older adults should get at least 150 minutes of moderate physical activity per week in series of at least 10 minutes continuously or 75 minutes of vigorous intensity per week in series of at least 10 minutes continuously in any of these four areas: Work, commuting/transport home, and leisure. However, besides not achieving the recommended values of physical activity, older people tend to spend too much time on tasks that require minimal energy expenditure, such as staying in a sitting position.



Watching TV, using the computer or mobile phone, working or studying in a table are examples of activities that require low energy expenditure. Older adults are the age group more exposed to sedentary behaviour, amounting to 65 to 80% of their waking time. There is evidence linking this exposure with an increased risk of mortality from all causes, chronic diseases such as diabetes mellitus, cardiovascular disease, and obesity.

Although they may be analyzed similarly, sedentary behaviour and physical inactivity are not the same, as they are constructs with different determinants and physiological health-related responses. Sedentary behavior does not imply the absence of physical activity or non-compliance with physical activity

recommendations (<150 min/week).

In this sense, it is possible to combine the two constructs based on the interaction of both behaviors, i.e., individuals may display enough physical activity up to the minimum of 150 minutes per week and still spend many hours a day in sedentary activities, or spend a few hours dedicated to low-energy expenditure activities similar to rest or accumulated levels of physical activity.

The two components may be also negatively affected, which is the least favorable scenario, or they may be both satisfactory, which is the ideal condition for health. In this sense, these behaviors are not mutually exclusive and they are influenced by historical conjunctures, technological apparatus, and modern lifestyle leading to setbacks in habits and routines. Today, much less time and intensity are spent in physical activity while much more time is dedicated to sedentary behavior.

Sedentary behavior is an emerging topic in public health, but the combined approach with physical activity allowing for deeper scrutiny of their relationship and their implications for health is even more recent [19, Rank 3]

GUIDELINES REGARDING PHYSICAL ACTIVITY FOR ADULT AMERICANS

In the last few decades, physical activity levels of Americans have decreased even though physical activity is associated with maintaining good health over the lifecycle. Major benefits of physical activity include protection against heart disease and diabetes. Several aspects of behaviour and predisposition to disease may differ, for example a high burden of obesity and diabetes. Those populations who have a relatively high level of work- and transportation-related physical activity may be qualitatively different from other forms of exercise, such as leisure time, and thus may have a different relationship with health outcomes.

According to the US Guidelines for Americans, adults should engage in at least 150 min to 300 min a week of moderate-intensity, or 75 min to 150 min a week of vigorous-intensity

aerobic physical activity, or an equivalent combination of moderate-to-vigorous activity (MVPA).

Physical activity helps protect against heart disease and factors related to the progression of type 2 diabetes by helping to reduce the risk factors of high blood pressure, body weight, blood lipids (cholesterol), and elevated haemoglobin A1c in individuals with type 2 diabetes. The beneficial effects on blood glucose (indicated by haemoglobin A1c) may also reduce other complications of type 2 diabetes. Moderate-intensity activity for at least 150 min a week plus 2 days a week of muscle-strengthening activities help to substantially lower the risk of heart disease. Three hundred minutes or more of moderate-intensity activity a week may lead to even greater benefit.

Sedentary behavior which is broadly defined as energy expenditure (<= 1.5 METs) and a posture of prolonged sitting and reclining) on the other hand, may raise cardiometabolic risk, due to effects of skeletal muscle contraction on metabolic function and the homeostatic regulation of body weight and fat mass which is based on loading, known as graviostat. According to the graviostat concept, the body's intrinsic weight sensor senses less weight during sedentary behavior, and in turn the body's regulatory mechanisms compensate by increasing body fat to keep body weight at a set point.

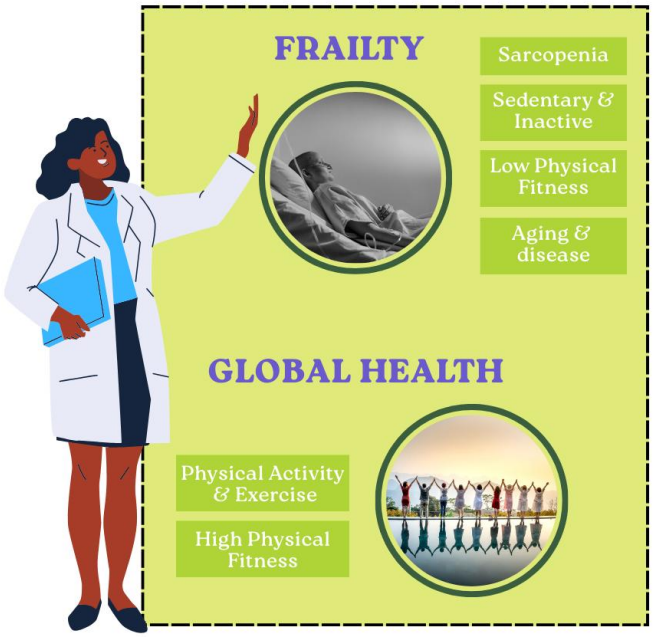
Diabetes has a strong association with sedentary behavior. Even light activity such as walking to interrupt sedentary behavior may be beneficial. Only a few national guidelines set targets for sedentary behavior; however additional data describing the dose-response patterns linking sedentary behavior levels with adverse health outcomes, independent of MVPA could motivate more countries to

address guidelines with respect to sedentary behavior levels. Reduction of sedentary behavior using intervention strategies such as preventing uninterrupted prolonged sitting by including breaks may be a particularly useful complementary strategy beyond promotion of MVPA. Public health strategies that will empower individuals to reduce sedentary behavior (e.g., increased walking, standing at work, taking breaks from sitting) are different than those that promote MVPA. [8, Rank 4]

THE ASSOCIATION BETWEEN FRAILTY AND SEDENTARY BEHAVIOUR

Frailty is a complex concept involving a state of greater vulnerability to adverse health factors, including falls, fractures, disability and an overall negative state of health, which are related to increased chances for morbidity and mortality. Reducing or eliminating risk factors and increasing protective factors are potential actions for minimizing the chances of frailty. Age, sex, diseases, social factors, economic factors, malnutrition, low levels of physical activity and greater time spent in sedentary behavior are known risk factors for frailty.

Regular physical activity promotes improvements in both physical and psychological health and contributes to the reversal of detrimental effects of chronic diseases as well as the maintenance of functional autonomy in older adults. However, physical activity levels have been decreasing over time as a result of the increasing use of technology in society, and this decrease is considered a worldwide pandemic. This fact is of major concern in older adults, as they more often present with insufficient activity levels when compared to other age groups. Insufficient physical activity is related to increased vulnerability to adverse health outcomes and, consequently, to higher probability for frailty in older adults.



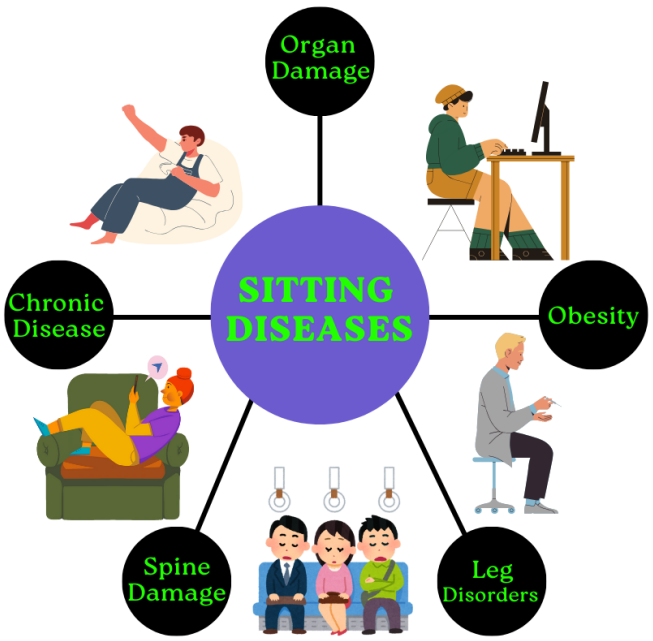
Research on the effect of behavior on frailty has primarily involved physical activities of moderate to vigorous intensity. However, the relationship between frailty and time spent in sedentary behavior in older individuals still warrants further investigation, as there is evidence of excessive sedentary behavior increasing the odds for disability, inflammatory processes and mortality in older adults, even in

individuals who meet the recommended levels of physical activity.

Previous studies have explored the relationship between frailty and either physical activity level or sedentary behavior alone in older adults. Understanding how these imminent risk factors at in combination in the frailty syndrome may enable the proposal of more assertive actions in promoting the maintenance of functional health in older adults. Preventing and delaying the onset of the frailty syndrome is essential for greater physical independence late in life, which is an important aspect for higher survival rates and quality of life [23, Rank 5]

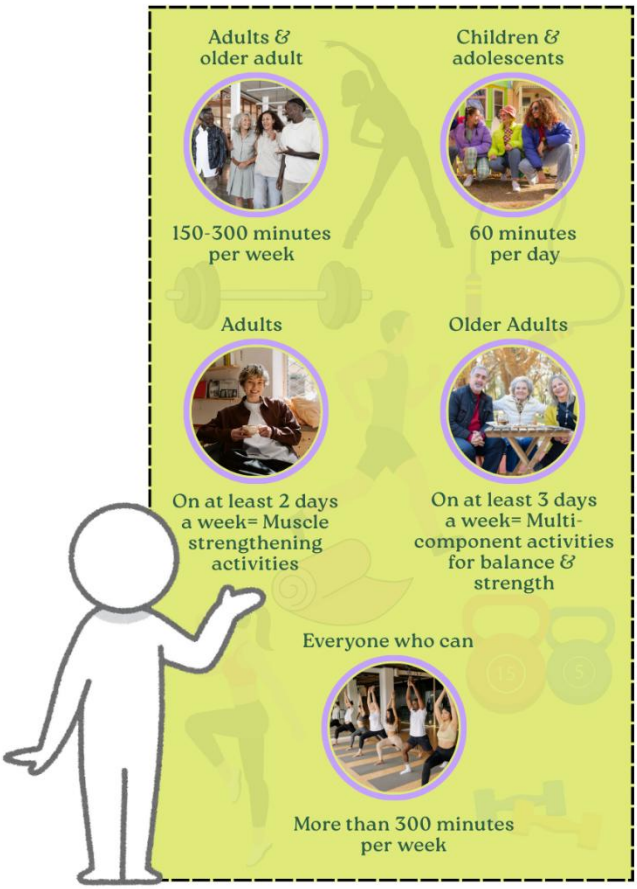
THE NEGATIVE HEALTH OUTCOMES OF CONTINUOUS SITTING

Physical activity (PA) has been inversely related to fatal and non-fatal cardiovascular disease (CVD). Attention has more recently been drawn to the association between sedentary behaviours and negative health outcomes, including CVD. Sedentary behaviour refers to any waking behaviour that involves an energy expenditure of less than 1.5 metabolic equivalent units (METs). This can include activities undertaken in sitting or lying, such as watching television or using a computer. It has been previously demonstrated that greater times spent sitting, viewing television, and using a computer may be unfavourably associated with ideal cardiovascular health. However, there are some inconsistencies in the literature, and several reviews have concluded that causal relationships between sedentary behaviour time and health outcomes need to be further clarified.



Low-density lipoprotein cholesterol (LDL) is an atherogenic, harmful lipoprotein, responsible for the atherosclerotic process and an increased risk for CVD. Elevated blood triglycerides have a dose-dependent association with cardiovascular-related and all-cause mortality. In contrast, high-density lipoprotein cholesterol (HDL) is related to a lower prevalence of cardiovascular mortality and incidence of coronary heart disease (CHD). In contrast to the research focused on relations between lipid levels and PA, fewer studies to date have examined associations between sedentary behaviour time and lipids. [22, Rank 5]

Television viewing time, regardless of day of the week, and computer time on a day off are negatively associated with an overall index of cardiovascular health. From a public health standpoint, this finding is important. A recent large prospective study has provided evidence that different sedentary behaviours may not have the same association with health outcomes, and television time, but not sitting at work or during transportation, was associated with overall and cardiovascular mortality. Therefore, reducing sedentary behaviour during 'free or leisure time' may be a particularly important message to those who have sedentary or computer-based occupations during the working week. [12, Rank 3]



Regular physical activity is a key protective factor for the prevention and management of NCDs – those who meet recommended levels of physical activity have a 20–30% reduced risk of premature death. About 7–8% of all cases of cardiovascular disease, depression and dementia, and about 5% of type-2 diabetes cases, could be prevented if people were more active.

The WHO launched the Global Action Plan on Physical Activity (GAPPA) 2018-2030 in 2018. GAPPA raises awareness of the need for accelerated whole-of-government efforts around the world to achieve the global target of a 15% relative reduction in the prevalence of physical inactivity by 2030.

The new Global Status Report on physical activity is the first dedicated global assessment of countries' progress in implementing GAPPA policy recommendations.

CONCLUSION

The increasing time spent in sedentary behaviours has emerged as a significant risk factor for metabolic syndrome, cardiovascular disease (CVD), and overall mortality. A growing body of research consistently demonstrates a strong association between prolonged sedentary behaviour and adverse cardiometabolic health outcomes, characterized by an elevated risk factor profile. Studies have shown that excessive sedentary

time correlates with higher waist circumference, elevated triglyceride levels, increased blood pressure, and impaired fasting plasma glucose, all of which contribute to an increased metabolic risk burden. Notably, objective measurements of sedentary time in an Australian population further reinforce these findings, highlighting its detrimental impact on metabolic health. Addressing sedentary behaviour alongside promoting physical activity is crucial for mitigating these risks and improving overall health outcomes in aging populations.