# WELL V2:

## EVIDENCE BEHIND THE **MOVEMENT** CONCEPT

# FEATURE V01: ACTIVE BUILDINGS AND COMMUNITIES

## OVERVIEW

**Part 1**: Promote all types of movement and reduce sedentary behavior through one of the specified options for designing active buildings and communities, giving flexibility to projects to select a strategy that best supports their context and needs.

## SCIENTIFIC BACKGROUND

- Active design refers to architectural or urban design that leverages features of the built environment to support movement, physical activity and exercise.[1,2]
- Physical activity is defined as any bodily movement that results in energy expenditure encompassing all types (e.g., aerobic, anaerobic), intensities (e.g., low, vigorous) and domains (e.g., play, active commuting, dance, yoga, running) of movement. Although sometimes used synonymously with the term exercise, physical activity is distinctly broader.[3]
    - Exercise is a specific type of physical activity that is planned, repetitive, structured and targeted towards one or more domains of physical fitness (e.g., cardiorespiratory endurance) and is typically discussed with reference to intensity.[3]
    - Incidental physical activity is defined as physical activity accumulated through the activities of daily living. These types of activities include active commuting (e.g., walking or biking to work or school) and doing household chores.[4]
- Physical inactivity refers to when people fail to engage in a sufficient amount of moderate-to-vigorous physical activity (MVPA).[5,6]
- Sedentary behavior is distinct from physical inactivity and poses unique health risks. It refers to any waking behavior while sitting or reclining that is typified by expending energy of ≤1.5 metabolic equivalent of task (MET).[5]
    - The metabolic equivalent of task (MET) is a widely used metric that describes the amount of physical activity a person undertakes to execute a given task or the energy cost of an activity. 1 MET is defined as 1 kcal/kg/hour and corresponds to the energy cost of sitting quietly.[7] Moderate-intensity physical activity corresponds to approximately 3-6 METs, and >6 METs corresponds to vigorous-intensity physical activity.[8]

## KEY HEALTH AND WELL-BEING EFFECTS

- Physical inactivity is a global public health challenge. About 25% of adults and 80% of children do not achieve the recommended levels of physical activity.[9]
    - The World Health Organization (WHO) recommends that adults between 18 to 64 years old engage in at least 150 minutes per week of aerobic moderate-intensity physical activity or at least 75 minutes per week of aerobic vigorous-intensity physical activity, or an equivalent combination of MVPA.[10]
    - The WHO recommends that children between 5 and 17 years old engage in at least 60 minutes per day of MVPA.[10]
    - Moderate-intensity physical activities include movements such as household chores or biking at a light effort. Vigorous-intensity activities include those such as hiking, running or lifting heavy loads. Low-intensity activities are those that we often accumulate through activities of daily living, including walking.[7]
- Physical inactivity, like smoking and an unhealthy diet, is a top risk factor for numerous chronic diseases, and evidence suggests that even as little as 30 minutes of daily, moderate physical activity such as brisk walking can help reduce risks of high blood pressure, cardiovascular disease, diabetes and some cancers.[11,12]
    - Physical activity provides many physical, mental and social benefits for people of all ages, but engagement tends to decline with age, especially in adults ≥ 65 years old.[13,14]
    - Low physical activity levels are particularly troubling in children as evidence suggests that childhood behaviors carry over into adulthood.[15]
- The economic cost of physical inactivity is substantial. It has been estimated that physical inactivity costs health-care systems around the world $53.8 billion in 2013 alone.[16]
- Minimizing sedentary behavior can reduce the risk of obesity, cardiovascular disease, type II diabetes, cancer and premature all-cause mortality (i.e., deaths from any cause in a given population or subset of a community across a certain length of time).[6,17-27]

- Studies indicate there is a dose-response relationship between regular physical activity levels and health outcomes, meaning that for every incremental increase in physical activity, there is a corresponding increase in health and wellness benefits.[28,29]
- New research based on advancements in wearable technologies, allowing researchers to capture smaller bouts and lower intensity physical activity, suggests that people accrue health benefits with even small amounts of low intensity physical activity.[3]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- Numerous aspects of building and community design can support movement and physical activity.
- For those who are able, using stairs burns calories, improves cardiovascular health and may even benefit cholesterol levels.[30-32]
    - There is promising but overall insufficient evidence that enhancing stairwells (e.g., introducing artwork or music) may promote stair use.[31,33]
    - There is strong evidence that point-of-decision prompts, such as motivational signage, are useful in getting people to take the stairs instead of using elevators or escalators.[33-35]
    - Evidence suggests that stairs are more likely to attract occupants when highly visible from common paths of travel and easy to access. A study found that the effective area/occupant load of stairs, the visibility of stairs and the number of turns required to travel to stairs explained 53% of stair use across ten buildings in a university campus.[36]
- Active commuting by bicycle is associated with a lower risk of all-cause mortality (i.e., deaths from any cause in a given population or subset of a population across a certain length of time).[37,38]
    - Secure parking for bicycles has been consistently demonstrated to be one of the most effective amenity provisions for encouraging active commuting, with indoor bicycle parking facilities valued higher than outdoor ones.[39-44]
    - On-site shower facilities are associated with increased rates of bicycling to work.[45] However, sustained improvements in bicycling attributed to showers and lockers may only be relevant when these facilities are coupled with other supportive amenities or policies.[46-48]
- Highly walkable neighborhoods, featuring pedestrian-friendly amenities and design, can encourage two times more walking compared to communities that are less walkable, translating to about 15 to 30 minutes more walking per day.[49]
    - While the most commonly assessed aspects of pedestrian-friendly design relate to neighborhood-level characteristics like land use diversity, other urban design qualities related to enhanced aesthetics may also promote more pedestrian activity.[50-53] Enhanced aesthetics can take the form of anything that makes outdoor spaces cleaner and safer or more comfortable or interesting, including physical features like outdoor plazas, street furniture, non-rectangular building shapes, accent colors and public art.[50,51,54]
- Providing convenient opportunities for maintained, consistent physical activity is a promising way to sustain improvements in health and well-being.[55,56]

# FEATURE V02: VISUAL AND PHYSICAL ERGONOMICS

## OVERVIEW

**Part 1**: Ensure that all monitors, including laptops, can be positioned by the user.
**Part 2**: Provide sit-to-stand desks or supplemental height-adjustment solutions for at least 25% of workstations.
**Part 3**: Provide ergonomic chairs that include adjustability features across at least three domains (e.g., seat depth, arm rests).
**Part 4**: Include anti-fatigue mats, recessed toe space, footrests/footrails or a leaning chair at all workstations where employees must stand for 50% or more of working hours.
**Part 5**: Orient employees to workstation adjustability features through in-person trainings, interactive education, smartphone-based education or similar trainings.

## SCIENTIFIC BACKGROUND

- Ergonomics is the study of people at work, deriving from the Greek word ergon meaning work or task, and the word erg, meaning a unit of energy or work in the metric system. As a scientific discipline, it's concerned with understanding and enhancing the relationship between the human body and the various environments within which it functions.
    - In the case of workplaces, ergonomics refers to a focus on fitting workplace conditions and demands to the needs of the worker or workforce at large.[57]
- Musculoskeletal disorders span more than 150 different diagnoses relating to issues of the locomotor system, including the muscles, nerves, bones, tendons, joints, ligaments, cartilage and spinal discs.[57,58]
- Work-related musculoskeletal disorders (WMSDs) are a subset of musculoskeletal disorders caused or exacerbated by the work environment or performance of work tasks.[57]
    - Musculoskeletal issues arise when the mechanical load of a task or activity overwhelms the capacity of the body.[57]
    - This can result from extensive physical exertion, as well as prolonged muscular inactivity, monotonous or repetitive tasks, or anything that forces the body into an uncomfortable or unnatural posture.[57]
- Humans engaged in any form of work are susceptible to physical and cognitive strains. These risks are particularly elevated when the exposure to the task is prolonged or repetitive, the environment or organizational structures are not supportive and/or education on proper work techniques is lacking.[57]

## KEY HEALTH AND WELL-BEING EFFECTS

- Approximately 6.8% of all disability-adjusted life years (DALYs) around the world resulted from musculoskeletal disorders (MSDs) in 2010.[59] Of this number, nearly half were accounted for by lower back pain and a fifth by neck pain.
    - Low back pain, neck pain, osteoarthritis and other MSDs are extremely common in nearly all populations, and lower back pain is estimated to affect 80% of adults at some point in their lifetime.[59,60]
    - To quantify the burden a disease puts on a population, researchers calculate disability-adjusted life years (DALYs), which represents one lost "healthy" year. DALYs are determined by summing the Years of Life Lost (YLL), which accounts for cases where people die prematurely due to disease, with the Years Lost due to Disability (YLD), which accounts for cases where people live with a condition or its consequences.[61]
- The impact of MSDs extends beyond health impacts. Productivity costs of MSDs are estimated to be as high as 2% of gross domestic product (GDP) in the European Union.[62] Similarly, WMSDs cause an average of 12 missed work days per year among adults in the United States.[57]
- Both prolonged sitting and standing can have deleterious health effects on the body, thus the ergonomics community promotes postural change and movement breaks as a fundamental strategy to support functional health.
    - Reducing bouts of and total prolonged sitting time may significantly reduce risk of obesity, cardiovascular disease, type II diabetes and premature death by all causes (i.e., deaths from any cause in a given population or subset of a population across a certain length of time).[6,19,20,24,26,63-65]
    - Standing for long periods of time is associated with an increased risk of discomfort or pain and places strain on the circulatory system, leading to venous pooling of blood and an increase in pressure in the lower extremities.[66] Extended standing also may induce foot, joint and back-pain, and increase the risk of developing varicose veins.[66]

- Visual strain is also common for computer-based workstations, which can be caused by position and quality of input devices, orientation of workstations to windows or other sources of glare and overall duration of exposure to screen without task switching or relief.[67]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- An ideal ergonomic work environment provides workstations that are conducive to the necessary breadth of tasks assigned to that space, while encouraging natural movements and postural changes as needed throughout the day.
    - Workstations and associated furnishings (e.g., chairs, monitors) should be designed to accommodate a variety of body sizes and shapes down to the 5$^{th}$ percentile of females and up to the 95$^{th}$ percentile of males.[68]
- Ergonomic interventions involve task analysis and risk identification; program design and implementation (often addressing workstation flexibility to allow greater user control); training and education; and on-going monitoring of outcomes.[57]
- Increasingly, modern ergonomic interventions extend beyond the workstation and examine a variety of workplace factors including design, policies and cultural practices that can impact the quality and quantity of our work.[69]
- It is difficult to evaluate outcomes associated with ergonomic interventions systematically. The outcomes of ergonomic programs can vary by intervention and employee population. But studies have generally found no adverse health effects associated with these types of occupational safety and health interventions.[70,71]
    - Overall, several studies suggest that ergonomic interventions can reduce discomfort related to musculoskeletal symptoms but do not have an impact on absenteeism.[72,73] Other studies evaluated in a systematic review report that ergonomic interventions may reduce the number of sick days taken but do not seem to alleviate musculoskeletal symptoms.[71]
- Beyond lighting quality and workstation orientation relative to sources of glare, providing flexibility for screens and similar input devices to be positioned optimally for the user may support visual comfort and reduce visual strain.[74]
- One of the most salient solutions to the health concerns associated with prolonged sitting is the use of standing workstations. However, since prolonged standing carries health concerns of its own, alternating periodically throughout the day, and ideally each hour, between seated and standing work is recommended.[75]
- Another prevalent workstation modification that is made in ergonomics interventions is to the chair. Chairs that are designed with customizability at their core allow users to sit comfortably, avoid abnormal strain and may ultimately prevent musculoskeletal issues.[76]
- A floor's effect on ergonomic comfort is a function of hardness, depth and other dynamics. Prolonged standing on hard surfaces can induce foot, joint and back pain, and contribute to body and lower limb fatigue.[66,77,78] Floor mats or other softening surfaces can help to alleviate these pains.[77,78]
- A person's knowledge of and training in ergonomics is as important to minimizing musculoskeletal symptoms as the design of the work environment itself. Ergonomics experts often note that advanced furniture features are infrequently used to their full potential, even to the detriment and discomfort of the users.[79] This suggests that education and awareness are critical in maximizing the success of ergonomic interventions.
    - Coupling workstation adjustments with professional ergonomic training may be more effective at reducing musculoskeletal pain and discomfort than workstation adjustments alone.[70,73]

## ADDITIONAL NOTES

- A growing body of research indicates that psychosocial factors play an active role in musculoskeletal discomfort and pain. Job control appears to be of particular significance, specifically related to decision latitude (sometimes called locus of control), or the extent to which a person can control and make decisions about their work.[80,81]
- Other organizational factors, such as work demand, peer or managerial support, effort-reward balance, quality of supervision, incentive pay and understaffing also play a key role in WMSDs.[82]
- Therefore, a truly comprehensive ergonomics intervention should consider these factors, referred to as taking a macro-ergonomic approach, to most effectively address workplace variables that influence musculoskeletal conditions, especially in office settings occupied primarily by knowledge workers.[81]
    - For example, one systematic review noted that workstation adjustments had minimal effects on musculoskeletal pain, and only the reduction of the amount of time working was predictive of fewer back, neck/shoulder and elbow/hand symptoms.[83]

# FEATURE V03: CIRCULATION NETWORK

## OVERVIEW

**Part 1**: Design staircases to include aesthetic elements that encourage their use.
**Part 2**: Implement point-of-decision signage at critical locations to encourage stair use.
**Part 3**: Ensure that at least one staircase is physically or visually placed before elevators or escalators.

## SCIENTIFIC BACKGROUND

- Active design refers to architectural or urban design that leverages features of the built environment to support daily movement, physical activity and exercise.[1,2]
    - The active design movement took shape in the 20th century as a response to research on the environmental drivers of chronic disease. Historically, movement was engineered out of daily life: decades of car-centric urban design shifted street priority away from pedestrians, favoring the automobile. Further, developing economies bring with them prosperity, but also more sedentary jobs.[84] These shifts, among other complex drivers, fundamentally altered the way we move.
- Choice architecture refers to the process of influencing and guiding behavior without eliminating any options or significantly changing economic incentives.[85]
- Behavioral nudges in the form of environmental design can be used to cue and encourage, or hinder and deter, certain actions to help promote population health.[85,86]
- Physical activity is defined as any bodily movement that results in energy expenditure encompassing all types (e.g., aerobic, anerobic), intensities (e.g., low, vigorous) and domains (e.g., play, active commuting, walking, cycling) of movement. Although sometimes used synonymously with the term exercise, physical activity is distinctly broader than exercise.[3]

## KEY HEALTH AND WELL-BEING EFFECTS

- Physical inactivity is a prominent global public health challenge. Globally, about 25% of adults and 80% of children do not achieve the recommended levels of physical activity.[9]
    - The World Health Organization (WHO) recommends that adults between the ages of 18 to 64 engage in at least 150 minutes per week of aerobic moderate-intensity physical activity or at least 75 minutes per week of aerobic vigorous-intensity physical activity, or an equivalent combination of moderate-to-vigorous physical activity (MVPA).[10]
    - The WHO recommends that children between 5-17 years old engage in at least 60 minutes per day of MVPA.[10]
    - Moderate-intensity physical activities that include movements such as household chores or biking at a light effort. Vigorous-intensity activities include those such as hiking, running or lifting heavy loads. Low-intensity activities are those that we often accumulate through activities of daily living, including walking.[7]
- Physical inactivity, like smoking and poor diet, is a top risk factor for numerous chronic diseases. Evidence suggests that even as little as 30 minutes of daily, moderate physical activity can reduce risks of high blood pressure, cardiovascular disease, diabetes and some cancers.[11,12]
- For those who are able, using stairs burns calories, improves cardiovascular health and may even benefit cholesterol levels.[30-32]
    - One estimation suggests that even just two additional minutes of stair climbing per day led to a weight reduction of more than 0.5 kgs [1.2 lbs] a year, effectively offsetting the average 0.45 kgs [1 lb] of weight gained per year by adults in the United States.[31]
    - A study of more than 10,000 men found climbing 20 or more flights of stairs per week was associated with a 20% reduction in risk of stroke or death by all causes.[87]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- There is promising but overall insufficient evidence that enhancing stairwells (e.g., introducing artwork or music) may promote stair use.[31,33] More studies are needed to evaluate the strength of this particular strategy in promoting more physical activity, but the available evidence does suggest that aesthetic improvements can increase stair use by nearly 9%.[33,88,89]

    - Aesthetic improvements can be used to supplement signage, but further research is needed to identify the effect of aesthetic interventions in isolation and to compare if there are differences in types of aesthetics improved (i.e., comparing effectiveness of music versus artwork versus views).[90]
- There is strong evidence that point-of-decision prompts are effective in getting people to take the stairs instead of using elevators or escalators and increasing levels of physical activity.[33-35] Studies indicate this strategy can increase stair usage by 50% (overall median across 11 studies).[33] The effectiveness of this intervention has been studied in a variety of spaces, including offices, public transportation stations, universities, retail environments and healthcare facilities.[34,90-96]
    - Point-of-decision prompts are motivational signage placed at locations where individuals would be presented with a choice to take one action or another. For example, signage highlighting the benefits of taking the stairs or otherwise encouraging stair use placed at the base of elevators or escalators, or on or near stairwells.[33] These also can be coupled with wayfinding signage, directing people to the nearest stairway as necessary.[33]
    - The majority of these studies focus on adult populations. More research is needed to understand if this is an equally appropriate intervention for children.[33]
- Signage should be tailored to the target population, including consideration of the specific health information communicated in such signage or the way the information is presented (e.g., cultural or linguistic factors, design or formatting).[97,98]
- Available evidence suggests that stairs are more likely to attract occupants when highly visible from common paths of travel and are easy to access.
    - A study found that the effective area/occupant load of stairs, the visibility of stairs and the number of turns required to travel to stairs explained 53% of stair use across ten buildings in a university campus.[36] The study also investigated factors related to everyday use and found that stairs with restricted access (i.e., requiring the use of keys or cards) were much less likely to be used for everyday travel, while stairs located within 7.6 m [25 ft] of an entrance and encountered before an elevator were more likely to be used for everyday travel.[36]

**ADDITIONAL NOTES**

- Encouraging stair usage is an appropriate strategy for physically able adults, but there are challenges presented for individuals with mobility limitations. This also includes considerations for older adults, who are likely to engage in leisure walking for physical activity but may experience more difficulty with stair climbing.[99]
- Therefore, active design strategies should balance physical activity promotion with the creation of environments that are accessible and inclusive for potential users.

# FEATURE V04: FACILITIES FOR ACTIVE OCCUPANTS

## OVERVIEW

**Part 1**: Provide bike-friendly streets in the area surrounding the building and an adequate number of end-of-trip facilities (bike parking) for cyclists.
**Part 2**: Provide an adequate number of showers, changing rooms and lockers for the project population.

## SCIENTIFIC BACKGROUND

- Decades of car-centric transportation planning has de-prioritized more active modes of commuting such as biking and walking.[100-102]
    - While some reports indicate that rates of bicycling may be declining in parts of the world, others report the rates of bicycling may be increasing in some specific locations like Amsterdam or London.[103]
- Incidental physical activity includes any physical activity accumulated through the activities of daily living. These types of activities include active commuting (walking or biking to work or school) or household chores.[104,105]
- Active commuting by bicycling corresponds to between 4.0-6.8 METs of energy expenditure, which classifies this kind of bicycling as moderate- to vigorous-intensity physical activity (MVPA).[7] Cycling at 4 METs (about 15 km/hr [9.3 mph]) for approximately 15 minutes, twice a day, can lead to an energy expenditure equivalent to about 4.5 kg [10 lbs] per year.[7]
    - The metabolic equivalent of task (MET) is a widely used metric that describes the amount of physical activity a person undertakes to execute a given task, or the energy cost of an activity. 1 MET is defined as 1 kcal/kg/hour and corresponds to the energy cost of sitting quietly.[7] Moderate-intensity physical activity corresponds to approximately 3-6 METs, and >6 METs corresponds to vigorous-intensity physical activity.[8]

## KEY HEALTH AND WELL-BEING EFFECTS

- Active commuting by bicycle is associated with a lower risk of all-cause mortality (i.e., deaths from any cause in a given population or subset of a population across a certain length of time).[37,38]
    - One study including about 30,000 Danish individuals reported a 40% reduction in risk of all-cause mortality, even after researchers controlled for physical activity levels.[106]
- Active commuting by bicycle also is associated with a lower risk of cardiovascular disease, in terms of both the incidence of disease and mortality.[107-109] Benefits may be more pronounced in women compared to men.[110]
    - Studies of active commuting typically examine the impacts of both walking and cycling. Regularly commuting to work by walking or biking for at least 30 minutes (a day) has been shown to improve aerobic fitness and decrease cardiovascular strain.[111,112] Cycling can lead to greater improvements in cardiorespiratory fitness (i.e., the body's ability to deliver oxygen to muscles during physical activity) compared to walking.[113-116]
- Health benefits of cycling may also include reduced risk of cancer.[37,109,114] One study found that colon cancer risk was reduced with hours spent per day on active commuting as well as with years of active commuting sustained.[117]
- Bicycling as transportation is further associated with lower rates of weight gain and obesity, and related lower body mass index scores, body fat and waist circumference.[24,60,101,118-125]
- Bicycling also may help to lower the risk of diabetes.[108,122] One study comparing individuals who bicycled to work to those who traveled to work through less active modes of transportation found that the prevalence of diabetes in active commuters was 7% lower.[122]
- Overall, there is evidence that bicycling may be associated with improvements in all-cause mortality, cardiovascular disease, cancer and diabetes in a dose-dependent fashion (i.e., depending on the amount of cycling). [109,114,122,126]
    - For example, in the meta-analysis above, which measured reduction in all-cause mortality, researchers categorized cycling levels into three groups (0-11.5 MET hours/week; 11.5-32 MET hours/week; 32-65 MET hours/week). Researchers found that the risk of all-cause mortality declined for each additional hour of cycling per week with the most pronounced effect in the first category. Groups reporting an additional 11.25 MET hours/week (roughly equivalent to global physical activity recommendations) reduced their risk of death by about 10%.[126]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- Secure parking for bicycles consistently has been demonstrated to be one of the most effective amenity provisions for encouraging active commuting, with indoor bicycle parking facilities valued by cyclists more than outdoor ones.[39-44]
- On-site shower facilities are associated with increased rates of bicycling to work.[45] However, sustained improvements in bicycling attributed to showers and lockers may only result when these facilities are coupled with other supportive amenities or policies such as incentives and other cultural supports.[46,48]
- The greatest improvements in active commuting typically require a comprehensive approach; comprehensive not only in facilities provided at the destination, but also those that address infrastructure related to bicycle routes and supportive policies where applicable, such as financial incentives or cultural perceptions of active commuting.[46,48,127,128]
- Increasingly, communities around the world are reprioritizing streets for pedestrians and cyclists as a means to increase physical activity at a community scale. The co-benefits of designing streets for pedestrians and cyclists extend beyond physical activity and health to also include economic and environmental benefits.[129]
    - Communities with greater density, connectivity and mixed-uses have higher rates of cycling and walking alike.[49] Infrastructure such as bike lanes and safety strategies such as traffic calming are shown to support ridership and promote pedestrian and cyclist safety.[129]

## ADDITIONAL NOTES

- Compared to some industrialized nations like Germany, Denmark and the Netherlands, studies indicate that in countries such as the United States and Australia, women tend to cycle less than men, suggesting that interventions that specifically engage more women to bicycle to work may be beneficial in some regions.[130,131]

# FEATURE V05: SITE PLANNING AND SELECTION

## OVERVIEW

**Part 1**: The project is located in an area that supports walking and pedestrian activity and also actively contributes to the pedestrian environment by locating buildings in areas that feature walkable neighborhood design and incorporating active design into the building's exterior.
**Part 2**: The project is located in close proximity to a robust mass transit system.

## SCIENTIFIC BACKGROUND

- The built environment reflects deliberate design decisions that either can promote or hinder physical activity behaviors and other health behaviors in a community.[132]
- Active design refers to architectural or urban design that leverages features of the built environment to support daily movement, physical activity and exercise.[1,2]
- Communities that are designed to support physical activity by incorporating a variety of human-centric design approaches benefit physical activity, health, social cohesion, economic vitality and environmental health.[133-135]
- Physical activity is defined as any bodily movement that results in energy expenditure encompassing all types (e.g., aerobic, anerobic), intensities (e.g., low, vigorous) and domains (e.g., play, active commuting, walking, cycling) of movement. Although sometimes used synonymously with the term exercise, physical activity is distinctly broader than exercise.[3]
    - Incidental physical activity is defined as physical activity accumulated through the activities of daily living. These types of activities include active commuting (e.g., walking or biking to work or school) or household chores.[4]
- Walking is reported to be the most common and preferable form of physical activity, particularly among older adults.[135,136] Walking is a popular focus of public health efforts that target population-level physical activity behaviors. Walking can be part of a variety of activities, including leisure time activities and active commuting.

## KEY HEALTH AND WELL-BEING EFFECTS

- Physical inactivity is a prominent global public health challenge. Globally, about 25% of adults and 80% of children do not achieve the recommended levels of physical activity.[9]
    - The World Health Organization (WHO) recommends that adults between 18 to 64 years old engage in at least 150 minutes per week of aerobic moderate-intensity physical activity or at least 75 minutes per week of aerobic vigorous-intensity physical activity, or an equivalent combination of moderate-to-vigorous physical activity (MVPA).[10]
    - The WHO recommends that children between 5-17 years old engage in at least 60 minutes per day of MVPA.[10]
    - Moderate-intensity physical activities include movements such as household chores, tennis or biking at a light effort. Vigorous-intensity activities include those such as hiking, running or lifting heavy loads. Low-intensity activities are those that we often accumulate through activities of daily living, including walking.[7]
- Physical inactivity, like smoking and an unhealthy diet, is a top risk factor for numerous chronic diseases. Evidence suggests that even as little as 30 minutes of daily, moderate physical activity, such as brisk walking, can reduce risks of high blood pressure, cardiovascular disease, diabetes and some cancers.[11,12]
- Studies indicate there is a dose-response relationship between regular physical activity levels and health outcomes, meaning that for every incremental increase in physical activity, there is a corresponding increase in health and wellness benefits.[28,29]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- Features of walkable neighborhoods vary throughout the literature but centralize around several core design themes: proximity, connectivity, density, safety and aesthetics.[135]
- Walkable neighborhoods, featuring some of all of the themes mentioned above, can encourage two times more walking compared to communities that are less walkable, translating to about 15 to 30 minutes more walking per day.[49] Greater walkability increases physical activity around the world for all ages, genders and body mass index

groups, with the most significant increases in activity in women.[137] Greater walkability also is associated with higher physical activity levels in older adults.[138-140]
    - Higher neighborhood walkability is associated with lower obesity prevalence, decreased incidence of diabetes, improved blood pressure outcomes and lower rates of depression.[141-143]
- Co-benefits, including reduced air pollution, lower pedestrian and cyclist injuries and improved perception of neighborhood quality and safety, also have been widely documented in the literature.[133]
- Communities that leverage strategic land-planning that prioritizes dense, proximate and diverse use types consistently are associated with higher physical activity than those communities that don't feature this type of planning.[102,144-146]
    - Great land-use mix is associated with increased levels of walking and biking.[147-149] In addition, mixed-use is negatively associated with body weight and obesity and is considered an important determinant of mobility and physical activity levels among older populations.[84,150]
- The presence of sidewalks can increase the number of walking trips per person.[49,53,151]
- Improved street connectivity (e.g., number of intersections) also is associated with increased physical activity.[152]
- Street design that considers safety, such as speed limits, visibility of pedestrians, and infrastructure to increase separation between motorists and pedestrians and cyclists create environments that are conducive to physical activity like walking and biking.[153,154]
    - There are a myriad of design strategies that support pedestrian safety in practice. Chief among them is regulating traffic speed. Speed is a factor in both crash risk and mortality for drivers and pedestrians alike.[154]
- Enhancing aesthetic design of the street environment can also help promote pedestrian activity.[50,51] Enhanced aesthetics can take the form of anything that makes outdoor spaces cleaner and safer or more comfortable or interesting, including features like outdoor plazas, street furniture, accent colors and public art.[50,51,54]
    - Adding greenery (especially trees) to the built environment is associated with increased walking.[155-157]
- Streets that give full priority to pedestrians and cyclists first came into the urban design spotlight in the 1970s. Numerous studies from Latin American cities have shown that open streets programs are associated with higher levels of physical activity (including biking and walking). They also are associated with increased activity for local businesses, improved social capital, and improved quality of life measures.[158]
- People who use public transit spend an average of 19 minutes per day walking to and from their public transit stop, and 29% spend 30 minutes or more walking per day.[159]
    - Many studies note positive associations between physical activity public transportation infrastructure. However, others report mixed findings. Further research is required to determine which built environment strategies can successfully increase physical activity.[152] For example, one review notes that the density of public transportation, but not the proximity to a given stop, may be associated with increased physical activity.[152,160,161]

**ADDITIONAL NOTES**

- The evidence, while spanning several countries and demographics, nevertheless skews more toward high-income countries and adults. More research is needed to understand the way neighborhood variables like walkability and mixed land use may affect people of different backgrounds, considering characteristics such as race, ethnicity, socioeconomic status, age, mobility and other factors.[49]

# FEATURE V06: PHYSICAL ACTIVITY OPPORTUNITIES

## OVERVIEW

**Part 1**: Offer no cost, age- and ability-appropriate physical activity opportunities within 200 m [650 ft] of the project boundary. Opportunities should be led by a qualified physical activity professional at a frequency that supports achievement of physical activity guidelines for all age groups.

## SCIENTIFIC BACKGROUND

- Physical activity is defined as any bodily movement that results in energy expenditure encompassing all types (e.g., aerobic, anerobic), intensities (e.g., low, vigorous) and domains (e.g., play, active commuting, walking, cycling) of movement. Although sometimes used synonymously with the term exercise, physical activity is distinctly broader than exercise.[3]
    - Exercise is a specific type of physical activity that is planned, repetitive, structured and targeted towards one or more domains of physical fitness (e.g., cardiorespiratory endurance) and is typically discussed with reference to intensity.[3]
    - Incidental physical activity is defined as physical activity accumulated through the activities of daily living. These types of activities include active commuting (e.g., walking or biking to work or school) or doing household chores.[4]
- Physical inactivity refers to when people fail to engage in a sufficient amount of moderate-to-vigorous physical activity (MVPA).[5,6]
- Workplaces and schools are a priority setting for health promotion, including physical activity promotion, particularly because these spaces help facilitate interventions across large groups of people.[162-166]

## KEY HEALTH AND WELL-BEING EFFECTS

- Physical inactivity is a prominent global public health challenge. Globally, about 25% of adults and 80% of children do not achieve the recommended levels of physical activity.[9]
    - The World Health Organization (WHO) recommends that adults between 18 to 64 years old engage in at least 150 minutes per week of aerobic moderate-intensity physical activity or at least 75 minutes per week of aerobic vigorous-intensity physical activity, or an equivalent combination of MVPA.[10]
    - The WHO recommends that children between 5-17 years old engage in at least 60 minutes per day of MVPA.[10]
    - Moderate-intensity physical activities include movements such as household chores or biking at a light effort. Vigorous-intensity activities include those such as hiking, running or lifting heavy loads. Low-intensity activities are those that we often accumulate through activities of daily living, including walking.[7]
- Physical inactivity is the fourth leading risk factor for global mortality, responsible for 6% of deaths worldwide.[167] Estimates suggest that achieving sufficient physical activity could prevent an estimated 21-25% of the global burden of breast and colon cancer on human life, 27% of the global burden of diabetes, and 30% of the global burden of ischemic heart disease.[167]
- Studies indicate there is a dose-response relationship between regular physical activity levels and health outcomes, meaning that for every incremental increase in physical activity, there is a corresponding increase in health and wellness benefits.[28,29]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- To accrue the most benefit across the physical, psychological, and cognitive domains, children and adults should engage in physical activity on a regular basis.[168-171] Therefore, providing consistent and convenient opportunities for exercise is critical to promoting health and well-being.
- There is strong evidence that physical activity programming at workplaces can be effective in increasing physical activity levels and also may be effective in reducing musculoskeletal disorders.[172] Further, some evidence suggests that workplace physical activity programming also may lead to improvements in work attendance, job satisfaction and job stress.[173]
    - These findings are based largely on studies with small sample sizes and of short duration. Studies with longer-term follow-up are needed to understand if changes in behavior related to physical activity promoted by worksite interventions are sustained over time.

- Offering on-site fitness classes can provide employees with an opportunity to more conveniently meet minimum physical activity recommendations. Studies indicate that offering classes at workplaces is more effective in increasing levels of exercise compared to providing facilities alone.[174] Higher participation in such classes may be achieved through offering a greater variety of classes.[175]
- Studies demonstrate that an effective way to promote more physical activity in children is by increasing the length of time students spend physically active in school (e.g., by adding opportunities or re-structuring curriculum and class-time activities) and providing students and teachers with enhanced training on physical education.[174,176,177]
    - Enhanced school-based physical education includes curriculum changes that substitute less active games with more active, higher-intensity games and lesson plans that incorporate more fitness and circuit training activities (i.e., high-intensity, sequential exercises performed in a specific order without rest to promote body conditioning and strength training).[178] Enhancing physical education through these kinds of modifications to lessons can maximize the amount of time students actually spend engaged in MVPA during total class time.[178]
- One common strategy for increasing physical activity in schools is through recess. Studies show that recess can effectively encourage students to be more active, but several factors may influence individual activity levels, such as the quality of outdoor facilities, self-efficacy and esteem, climate and peer pressure, as well as demographic characteristics such as socioeconomic status and gender.[179-185]

**ADDITIONAL NOTES**

- Workplace health promotion programs have been increasing in popularity in organizations, but employee participation is typically very low.[186]
- Low participation rates compromise the effectiveness of workplace interventions in improving employee health outcomes.[162,163,187]
- Organizations must take care to design programs that are culturally and contextually relevant to the population they serve and properly communicate and support engagement programming and promote a broader culture of health, wherein participation is encouraged by leadership, management and colleagues alike.[164,188]

# FEATURE V07: ACTIVE FURNISHINGS

## OVERVIEW

**Part 1**: Provide a combination of active workstation options, such as sit-stand, treadmill or stepper machines for the maximum number of workstations possible.

## SCIENTIFIC BACKGROUND

- Sedentary behavior refers to any waking behavior while sitting or reclining that is defined by expending energy of ≤1.5 metabolic equivalent of task (MET).[5]
    - The metabolic equivalent of task (MET) is a widely used metric that describes the amount of physical activity a person undertakes to execute a given task, or the energy cost of an activity. 1 MET is defined as 1 kcal/kg/hour and corresponds to the energy cost of sitting quietly.[7] Moderate-intensity physical activity corresponds to approximately 3-6 METs, and >6 METs corresponds to vigorous-intensity physical activity.[8]
- Physical inactivity refers to when people fail to engage in a sufficient amount of moderate-to-vigorous physical activity (MVPA).[5,189]
    - The World Health Organization (WHO) recommends that adults between 18 to 64 years old engage in at least 150 minutes per week of aerobic moderate-intensity physical activity or at least 75 minutes per week of aerobic vigorous-intensity physical activity, or an equivalent combination of MVPA.[10]
    - The WHO recommends that children between 5-17 years old engage in at least 60 minutes per day of MVPA.[10]
    - Moderate-intensity physical activities include movements such as household chores or biking at a light effort. Vigorous-intensity activities include those such as hiking, running or lifting heavy loads. Low-intensity activities are those that we often accumulate through activities of daily living, including walking.[7]
- In recent years, a rapidly forming and strong body of research has identified sedentary behavior as a unique health risk, independent of whether or not a person is meeting physical activity guidelines.[19,63-65,189]
    - Results from a national survey in the United States showed that the average person spends more than seven hours per day sitting, and adults under the age of 60 spent 60% of their time engaging in sedentary behaviors.[190]

## KEY HEALTH AND WELL-BEING EFFECTS

- Minimizing sedentary behavior may significantly reduce risk of obesity, cardiovascular disease, type II diabetes and premature death by all causes (i.e., deaths from any cause in a given population or subset of a population across a certain length of time).[19,20,24,26,63-65,189]
- Breaking up time spent sitting with low intensity movement such as walking reduces risk of numerous chronic diseases and also may offer immediate benefits to the body related to improved insulin and glucose levels.[191-193]
- Studies conducted in countries around the world suggest that reducing sedentary behavior may be associated with fewer instances of several types of cancer, including lung, breast, ovarian, prostate, testicular, stomach, endometrial and colorectal cancer.[194-201]
- Static positions of any kind, whether they involve prolonged sitting or prolonged standing, can cause physical discomfort and contribute to body aches, making the use of dynamic workstations a promising way to help prevent musculoskeletal pain by allowing people to shift between sitting and standing as desired.[202,203]
    - One study showed that two hours of continuous standing computer work led to greater discomfort across the whole body. While it appeared to have a negative impact on productivity in terms of sustained attention reaction time, it also appeared to improve creative problem solving.[202] This study further highlights that moving between static positions is critical for both comfort and work performance.

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- In a systematic review of the use of sit-stand desks, research found that sit-stand workstations were effective at reducing total sitting time and sitting bouts lasting 30 minutes or longer (with decreasing efficacy over studies with longer duration). Studies found the intervention to be effective alone and in combination with other strategies such as counseling or education.[204]

- The provision of sit-stand desks at work has been shown to reduce neck and back pain by 54%, improve subjective reports of mood and cut down on average time spent sitting by about an hour per day.[202,203,205]
- The use of workstations that provide opportunities for low intensity activity (e.g., walking and cycling desks) may be a promising way to get people more active, improve worker satisfaction and engagement and reduce stress without compromising productivity.[206-208]

**ADDITIONAL NOTES**

- The use of sit-stand desks tends to be in work environments typified by office work focused on high-income countries and office environments. These findings may not be generalizable to other work environments that demand more active work styles.[204]
- While studies suggest that standing desks and other types of active workstations can reduce sedentary behavior, the quality of evidence on the effectiveness of such interventions is low. This is owing largely to study design limitations.[204]

# FEATURE V08: PHYSICAL ACTIVITY SPACES AND EQUIPMENT

## OVERVIEW

**Part 1**: Provide a no-cost, dedicated indoor physical activity space that is sized appropriately, either on-site or within 200 m [650 ft] of the project boundary.
**Part 2**: Provide no-cost access to at least one outdoor physical activity space (e.g., recreational field, gym, walking path) within a 400 m [0.25 mi] walk distance of the project boundary.

## SCIENTIFIC BACKGROUND

- Physical activity is defined as any bodily movement that results in energy expenditure encompassing all types (e.g., aerobic, anerobic), intensities (e.g., low, vigorous) and domains (e.g., play, active commuting, walking, cycling) of movement. Although sometimes used synonymously with the term exercise, physical activity is distinctly broader than exercise.[3]
    - Exercise is a specific type of physical activity that is planned, repetitive, structured and targeted towards one or more domains of physical fitness (e.g., cardiorespiratory endurance).[3]
- Physical fitness is multidimensional and is defined by the U.S. Centers for Disease Control and Prevention (CDC) as "the ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and respond to emergencies."[3]
    - Physical fitness is generally operationalized through multiple constructs, including cardiorespiratory and musculoskeletal fitness, balance, flexibility and speed/agility.[3]
- Cardiorespiratory fitness refers to the ability of the circulatory and respiratory systems to supply oxygen to the working muscles for extended periods of time.[10] It is typically assessed through a $VO_2$ max test, or the maximum amount of oxygen that a person's body can use over increasingly intense physical activity.[10]
- Muscular fitness refers to several parameters including strength (force exerted by a muscle), power (how much 'work' a muscle produces as a product of force and time) and endurance (ability to sustain power over a period time).[10,29]

## KEY HEALTH AND WELL-BEING EFFECTS

- The World Health Organization (WHO) recommends physical activity for cardiorespiratory and muscular fitness for all age groups starting from age five.[10]
    - Muscle strengthening activities, and particularly impact activities, such as stair climbing and jumping, support bone development in children.[3,10]
    - Physical activity, and especially muscle strengthening activity, is critical for maintaining a healthy lifestyle and retaining every-day-life functionality as we age. It is especially important in older adult populations.[3,10]
- Improved cardiorespiratory fitness is associated with reduced risks of both morbidity and mortality (i.e., disability and death) from coronary heart disease, cardiovascular disease, stroke and high blood pressure.[10,209-213]
- Aerobic activity is most commonly associated with cardiorespiratory health.[10,29] These activities involve large muscles moving in a rhythmic fashion for an extended period of time, such as brisk walking, running, bicycling, jumping rope and swimming — all of which are associated with improved cardiorespiratory fitness.[10]
- Improved musculoskeletal fitness is associated with improved outcomes related to cardiovascular disease and metabolic health, as well as reduced risk of developing functional limitations, osteoporosis (both common with aging) and all-cause mortality (i.e., deaths from any cause in a given population or subset of a population across a certain length of time).[10,210,214-221]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- Providing convenient opportunities for physical activity is a promising way to help promote health and well-being.[3,55,56]
- Research has shown that closer proximity to and higher density of fitness facilities (e.g., gyms) is associated with frequency of physical activity and exercise.[3,222,223]
    - Research has found that underprivileged communities tend to have fewer community physical activity assets (e.g., parks, gyms), which, among other factors, is associated with disproportionate rates of physical inactivity.[222]

    - Research also shows that proximity and access to indoor and outdoor activity spaces to be particularly important for children, especially girls.[3]
- Financial incentives can be used to promote healthier behavioral changes.[224] A particularly popular strategy is to offer subsidized or no-cost gym memberships. Studies indicate that such offerings can be effective in promoting initial gym attendance. But findings are mixed on whether these new behaviors become sustained habits, suggesting that such strategies should be coupled with other behavioral strategies, such as individually-tailored interventions, goal setting or the provision of additional social support or counseling.[225-229]
- Access to parks and greenspaces (i.e., proximity to physical activity assets) is widely documented in the literature to be an important factor in physical activity behaviors.[3]
    - Similar to fitness facilities, proximity to parks and the density and overall quality of parks has been found to be predictive of physical activity.[230]
    - Greenspaces like parks have extensive co-benefits for community health beyond physical activity levels. They connect us to nature, provide us with opportunities for social interaction and are vibrant components of communities.[231]

# FEATURE V09: PHYSICAL ACTIVITY PROMOTION

## OVERVIEW

**Part 1**: Provide at least two physical activity incentives (financial or non-monetary) to eligible employees and demonstrate uptake among employees. Implement programs to decrease sedentary behavior and increase daily physical activity in schools as appropriate.
**Part 2**: Monitor physical activity program engagement and report anonymized data annually to the WELL digital platform.

## SCIENTIFIC BACKGROUND

- Physical activity is defined as any bodily movement that results in energy expenditure encompassing all types (e.g., aerobic, anaerobic), intensities (e.g., low, vigorous) and domains (e.g., play, active commuting, walking, cycling) of movement. Although sometimes used synonymously with the term exercise, physical activity is distinctly broader than exercise.[3]
    - Exercise is a specific type of physical activity that is planned, repetitive, structured and targeted towards one or more domains of physical fitness (e.g., cardiorespiratory endurance) and is typically discussed with reference to intensity.[3]
    - Incidental physical activity is defined by physical activity accumulated through the activities of daily living. These types of activities include active commuting (walking or biking to work or school) or household chores.[4]
- Physical inactivity refers to when people fail to engage in a sufficient amount of moderate-to-vigorous physical activity (MVPA).[5,6]
- Workplaces and schools are a priority setting for health promotion, including physical activity promotion, mainly because these spaces help facilitate interventions across large groups of people.[162-166]

## KEY HEALTH AND WELL-BEING EFFECTS

- Physical inactivity is a prominent global public health challenge. Globally, about 25% of adults and 80% of children do not achieve the recommended levels of physical activity.[9]
    - The World Health Organization (WHO) recommends that adults between 18 to 64 years old engage in at least 150 minutes per week of aerobic moderate-intensity physical activity or at least 75 minutes per week of aerobic vigorous-intensity physical activity, or an equivalent combination of MVPA.[10]
    - The WHO recommends that children between 5-17 years old engage in at least 60 minutes per day of MVPA.[10]
    - Moderate-intensity physical activities include movements such as household chores or biking at a light effort. Vigorous-intensity activities include those such as hiking, running or lifting heavy loads. Low-intensity activities are those that we often accumulate through activities of daily living, including walking.[7]
- Physical inactivity, like smoking and poor diet, is a top risk factor for numerous chronic diseases. Evidence suggests that even as little as 30 minutes of daily, moderate physical activity such as brisk walking can reduce risks of high blood pressure, cardiovascular disease, diabetes and some cancers.[11,12]
    - Low physical activity levels are particularly concerning in children as evidence suggests that childhood behaviors carry over into adulthood.[15]
- The economic cost of physical inactivity is substantial. It has been estimated that physical inactivity costs healthcare systems around the world $53.8 billion in 2013 alone.[16]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- Financial incentives are effective in driving higher participation and engagement in workplace wellness programs.[232-234] Research indicates that the monetary value of the incentive matters, wherein higher values track with higher engagement in desired health behaviors.[235] Other factors, such as how the incentive is designed (e.g., the frequency at which it is given), seem to matter less so long as the amount of the incentive is acceptable to the population and the incentive is offered as part of a comprehensive program (e.g., education, support from leadership).[236]
    - While there is ample evidence regarding the impact of incentives on motivating certain preventive behaviors, such as health screenings or tobacco cessation, there are fewer studies that examine the relationship between incentives and physical activity.[233,234,237]

- Effective incentives are not limited to financial rewards. Studies demonstrate that non-financial incentives, such as offering wearables or paid leave time, can be as powerful as financial rewards in driving engagement in wellness programming.[238,239]
- There is strong evidence that physical activity programming at worksites is effective in increasing physical activity levels.[172] Further, some evidence suggests that workplace physical activity programming also may lead to improvements in work attendance, satisfaction and stress levels.[173]
    - These findings are based on studies with small sample sizes and of a short duration. Studies with longer-term follow-up are needed to understand if changes in physical activity behavior related to workplace interventions are sustained over time.
- Workplace health promotion programs have been increasing in popularity in organizations, but employee participation is typically very low.[186] Low participation rates directly influence the effectiveness of workplace interventions in improving employee health outcomes.[162,163,187] Therefore, beyond simply providing access to opportunities, organizations must take care to properly communicate and support engagement and promote a broader culture of health wherein participation in workplace programming is encouraged by leadership, management and colleagues alike.[164,188]
- Studies have demonstrated that an effective way to promote physical activity in children is by increasing physical activity opportunities in schools and providing teachers with enhanced training in physical activity and physical education.[174,176,177]
- Studies show that recess can effectively encourage students to be more active.[181,182] Several factors may influence individual activity levels, such as the attractiveness of outdoor facilities, school climate, peer pressure and demographic characteristics, such as socioeconomic status and gender.[179,180,183-185]
- In several countries, school-based interventions that target screen-time in children have been shown to be effective in reducing sedentary behaviors.[240] Interventions can range from using monitoring devices to limit screen time to "turn off the TV" challenges or the use of other types of activities or content to supplant recreational screen time.[240]

# FEATURE V10: SELF-MONITORING

## OVERVIEW

**Part 1**: Provide wearable devices that are no-cost, or subsidized by at least 50%, to all eligible employees that allow people to self-monitor physical activity metrics, such as steps taken, distance travelled, or floors climbed and additional health behaviors.

## SCIENTIFIC BACKGROUND

- The global market for wearable devices was valued at $26 billion within the overall $828 billion physical activity economy in 2018.[241]
    - The physical activity economy encompasses consumer spending across fitness, sport, and mindful movement along with supportive sectors, including equipment, apparel and technology.[241]
- The use of self-monitoring devices such as consumer-grade activity trackers as a tool for improving physical activity behaviors is based heavily on building self-efficacy, awareness of underlying behaviors, goal setting and feedback.[242] Physical activity trackers offer a key benefit as they provide individuals with objective monitoring and feedback on physical activity behaviors, which can support individuals in maintaining and adopting healthier behaviors.
    - Reporting bias is common with self-reported measurement methods of physical activity, wherein individuals tend to overreport physical activity behaviors.[243]

## KEY HEALTH AND WELL-BEING EFFECTS

- Physical inactivity is a prominent global public health challenge. Globally, about 25% of adults and 80% of children do not achieve the recommended levels of physical activity.[9]
    - The World Health Organization (WHO) recommends that adults between 18 to 64 years old engage in at least 150 minutes per week of aerobic moderate-intensity physical activity or at least 75 minutes per week of aerobic vigorous-intensity physical activity, or an equivalent combination of moderate-to-vigorous physical activity (MVPA).[10]
    - The WHO recommends that children between 5-17 years old engage in at least 60 minutes per day of MVPA.[10]
    - Moderate intensity physical activities include movements such as household chores or biking at a light effort. Vigorous intensity activities include those such as hiking, running or lifting heavy loads. Low intensity activities are those that we often accumulate through activities of daily living, including walking.[7]
- Physical inactivity, like smoking and poor diet, is a top risk factor for numerous chronic diseases, and evidence suggests that even as little as 30 minutes of daily, moderate physical activity such as brisk walking can reduce risks of high blood pressure, cardiovascular disease, diabetes and some cancers.[11,12]
- The economic costs of physical inactivity is substantial. It has been estimated that physical inactivity costs healthcare systems around the world $53.8 billion in 2013 alone.[16]
- Studies suggest that reducing sedentary behavior globally may be associated with fewer instances of several types of cancer, including lung, breast, ovarian, prostate, testicular, stomach, endometrial and colorectal cancer.[194-201]
- Studies indicate there is a dose-response relationship between regular physical activity levels and health outcomes, meaning that for every incremental increase in physical activity, there is a corresponding increase in health and wellness benefits.[28,29]
- New research, based on advancements in wearable technologies suggest that people accrue health benefits with any amount of physical activity.[3]

## HEALTH PROMOTION BENEFITS AND STRATEGIES

- A comprehensive review of the literature concluded that wearables help increase physical activity levels.[240]
    - Studies report that wearables are generally more effective at increasing physical activity. When paired with additional structured programming, such as goal setting or coaching, the effectiveness of wearables is particularly pronounced.[244-248]
- The use of self-monitoring devices to track physical activity levels as part of workplace wellness programs is growing in popularity and has been evaluated positively by employees as a strategy.[241,249-251]

- Studies show that the use of a self-monitoring device for improving physical activity may not only effectively decrease sedentary time, but also may increase time spent engaged in MVPA.[252-259]

**ADDITIONAL NOTES**

- More studies are needed to evaluate the efficacy of self-monitoring tools on behavior change across different populations. Studies investigating these topics have tended to have small sample sizes, collect observations over short durations and often report findings with unknown generalizability to broader populations. In particular, more studies are needed to help assess the effectiveness of self-monitoring devices and technologies among children and adolescents, as well as in communities affected by health disparities.[260-262]
    - Some questions still remain regarding whether the use of self-monitoring devices supports sustained behavior change as many studies take place over a short duration and lack longitudinal data.[3]
- As an intervention, it is also important to consider data security and privacy when using or recommending wearable devices or technologies, including the data collection methods, the relative transparency of what data are collected and for what purpose, and questions around data ownership and usage and disclosure rights.[263,264]

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