

**Proposal: Activity Facilitating Equipment for Sedentary Behavior
and Prolonged Sitting Intervention**
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Summary

The purpose of this proposed intervention is to mitigate the long-term impacts of sedentary behavior and counteract the short-term effects of prolonged sitting. College students, and notably Cornell University students, engage in prolonged sedentary periods especially during the academic semester. Several equipment-based interventions have been tested and verified as mitigating mechanisms. This proposal introduces three specific equipment based, worksite interventions—the treadmill workstation, the under the desk cycle, and the Swopper© chair—and the feasibility of implementing this equipment in a university setting. This report also details the logistics, budget and other considerations for implementation of the equipment in the Bissett Collaborative Center at Cornell University.

Issue Definition

This issue has two dimensions—the first part involves long-term effects of a sedentary lifestyle and the second dimension involves the short-term impacts of prolonged sitting. I will address these issues separately and then I will discuss common contentions. I will also allude to additional benefits gained from an active intervention method like activity facilitating equipment.

Long Term Impacts of Sedentary Lifestyle

In just two generations our pattern of sedentary behavior has increased significantly. In fact, approximately 3.2 million people die each year as a result of physical inactivity, making it the fourth leading cause of global mortality (14). Many adults spend 70% or more of their waking hours in a sitting position (1). “Sedentary jobs have taken the place of manual labor, cars have replaced walking or biking, elevators and escalators have supplanted stair climbing, and televisions, computers, and video games have displaced active leisure pursuits, especially among children” (20). To adapt to modern day social and work environments, Americans spend time sitting while commuting, spend time sitting while at work and school, and spend time sitting at home watching television. In fact, the average American spends five sedentary hours, daily, just driving and watching television (1). “Put simply, most of us are likely to move from chair to chair throughout our daily lives” (2). Further, less than half of all American adults reach minimum suggested levels of physical activity, subjecting themselves to a compromising position health wise (2).

It is important to highlight the two major elements of “sedentary behavior”. The first component of sedentary behavior is too much time sitting, and the second is too little exercise (1). Sitting is defined by posture type, and involves that of reclining or being seated (2). Lack of exercise deals with MET expenditure, or Metabolic Equivalent, at levels of 1.0-

1.5 METs where 1.0 MET denotes the average resting energy expenditure of a healthy adult (2). In order to break out of the sedentary range, MET expenditure must exceed 1.5. Exercise exceeding 1.5 METs, 2.9 METs and >6 METs are respectively low-intensity activity i.e. walking, moderate-intensity, i.e. housework and light lifting, and vigorous intensity activity, i.e. running and fast cycling (3, 1). The recommended minimum levels of physical activity for adults are 150 minutes of moderate-intensity activity or 75 minutes of vigorous intensive activity, and again, the majority of American adults are not achieving these levels.

Beyond this, evidence from a number of “large-scale epidemiologic observational studies” in tandem with “recent findings from controlled laboratory experiments” has acknowledged “the distinct metabolic and other health-related impacts of excessive sitting time” (2). Further, “these relationships are apparent even after accounting for the deleterious consequences that flow from lack of physical activity during leisure time” (2). Moreover, sedentary time is independently correlated with an increased risk of metabolic disease (15). Sedentary behavior has been associated with the manifestation of risk factors for chronic disease including central adiposity (larger waist size), increased and unhealthy levels of blood glucose, unhealthy levels of insulin and blood fat, increased cardiovascular disease, cancers including breast, colon and endometrial, and all-cause mortality among other associations (1, 2, 5, 6).

In addition, muscle degeneration can result from prolonged sitting. The range of motion in the hip is compromised and glutes become limp, compromising an individual’s ability to push off surfaces and “maintain a powerful stride” (5). Further, leg disorders can arise from sitting for long periods. Deep vein thrombosis, a condition when dangerous blood clots form, and varicose veins are examples of circulation issues stemming from prolonged sedentary behavior (5). Soft leg bones are another product of sedentary behavior that may be attributed to recent patterns of osteoporosis (5). Research has also suggested that prolonged sitting can impair the lumbar range of movement of both flexion and extension (4). “People who sit more are at greater risk for herniated lumbar disks” and spine inflexibility is also an impact of prolonged sedentary patterns (5). With this in mind, individuals can replace sedentary periods with light-intensity activity to mitigate health risks and gain additional benefits such as greater energy expenditure and weight management (1).

Short-Term Impacts of Prolonged Sitting

Beyond the long-term health risks associated with sedentary behavior, there are short-term impacts of protracted sitting. Swollen ankles, strained neck, and sore shoulders and back are side effects of sitting for a prolonged period (5). In addition, “foggy brain,” or slowed brain function can occur after protracted sedentary behavior (5).

In addition, a study documented an elevated postprandial glucose and insulin response in overweight and obese adults during prolonged sitting in comparison with individuals who sat with brief activity interruptions (6). Further, “sitting for more than 1 hour has been shown to induce biochemical changes in lipoprotein lipase activity (an enzyme

involved in fat metabolism) and in glucose metabolism that leads to the deposit of fats in adipose tissue rather than these being metabolized by muscle” (8). One study concluded, “detrimental cardiometabolic effects may already occur within 1 day of prolonged sitting, even in young and healthy adults” (9). However, interrupting sitting time with light-intensity activity can benefit cardiometabolic health (7). While the long-term impacts of sedentary behavior are more severe in nature and frequent in quantity, short term impacts also generate discomfort and may be addressed through equipment based intervention.

Why Changing to a Standing Position Isn't Enough

A recent trend, especially in offices, has been to transition from a sitting desk to standing desk to decrease sedentary behavior patterns (8). However, standing, independently, will not mitigate the effects of sitting in the same way as activity breaks. In addition, protracted standing increases the risks of varicose veins, puts a greater strain on the circulatory system, and places pronounced stress on the legs and feet (8). Task performance, particularly those requiring fine motor skills, is also compromised during prolonged standing (8). Thus, standing cannot be regarded as a suitable alternative to prolonged sitting.

Why Incorporating Moderate and Intensive Exercise Into Your Routine Isn't Enough

A logical response to counteract the negative health impacts stemming from sedentary behavior is to engage in the opposite behavior—moderate to vigorous-intensity. However, the detrimental health outcomes from sedentary behavior patterns persist despite high levels of moderate to vigorous-intensity activity. In one study, “watching television for seven or more hours per day,” despite engaging in more than 7 hours of moderate-intensity weekly activity, “was associated with a 50% greater risk of all-cause mortality and double the risk of cardiovascular mortality compared to those who watched <1 hour/day of television” (2). In addition, although there is currently limited evidence, a strong case exists “that there will be significant potential health benefits from addressing sedentary time among those with movement disabilities” (2). This is not to say that engaging in moderate to vigorous-intensity activity is not healthy or important. As previously stated, 150 minutes of moderate-intensity activity or at least 75 minutes of vigorous-intensity activity are recommended to maintain health (2). Rather, research has highlighted that moderate to vigorous-intensity activity is not an appropriate intervention or method to counteract the effects directly stemming from sedentary behavior patterns and prolonged sitting.

Relevance of Intervention to Cornell University

The motivation for this intervention, specifically at Cornell University, was derived from observation and expressed concern for rates of sedentary behavior among students (11). Beyond observation of students sitting for several hours in duration, students are

often observed renewing studying rooms beyond the 4-8 hour initial rental time, and renewing library resources beyond the 4 initial hour rental time (11).

In addition, in order to receive full time status, a Cornell University Student must enroll in 12 academic credits. This equates to, at minimum, 34 weekly hours of classroom and work time. Often, students enroll in more academic credits than 12, corroborating the potential for many sedentary hours weekly (12). In addition, even if students are meeting the recommended physical activity guidelines, as previously discussed, “sitting for prolonged periods can compromise metabolic health” (13). Due to the demands of class time and outside work, college students are a high-risk population for sedentary behavior patterns and the accompanying negative health outcomes. This intervention aims to address the issue of sedentary behavior among students by introducing techniques to mitigate inactivity.

Target Audience

The target audience for this proposal is full-time Cornell University students who spend 34+ weekly hours in a sedentary state. Students taking the minimum full time student credit load will meet the requirements of this population.

Recommended Intervention

There are three pieces of equipment that may be utilized to counteract the negative health impacts resulting from sedentary behavior patterns and prolonged sitting. The suggested pieces of equipment all allow students to continue to do their work, and may actually enhance their performance, while facilitating motion or light-intensity activity. The equipment is not intended for extended use nor is it intended as a replacement to moderate to vigorous-intensity activity. Rather, the equipment suggested in this proposal will provide students with an opportunity to take a necessary break during prolonged sitting. This report will detail each piece of recommended equipment individually.

Treadmill Workstations

Why the treadmill workstation?

The treadmill workstation has been the subject of many studies with positive results regarding its potential to mitigate short and long-term health impacts of sedentary behavior. In addition to its potential to mitigate prolonged sitting effects, researchers also found that users’ “overall work performance, quality and quantity of performance, and interactions with coworkers improved as a result of adoption of treadmill workstations” (10). In addition, “daily total physical activity increased as a result of the



Suggested model: LifeSpan® TR1200-DT5

adoption of treadmill workstations” (10).

Further, this piece of equipment is a great match for the needs of Cornell University students. Recommended for short use, students will be able to engage in light-intensity physical activity without impeding on their designated study time. In addition, the library is able to accommodate the dimensions of the units.

Features (21):

- Desk height can be adjusted from 41” to 55” to allow for a variety of users to find an ergonomic position.
- 38” wide desk top to accommodate a laptop computer with room for other relevant materials i.e. notebooks.
- “Whisper-Quiet 2.25 HP Continuous-Duty Motor” to keep noise to a minimum and prevent disruption; suppressed mechanical noise and subdues vibrations.
- Supports up to 350 pounds.
- Automatically pauses; Intelli-Guard™ safety technology.
- Counts steps, distance, etc. with ability to graph and generate overviews.
- Able to connect via social media and with apps.

Specs (21):

- 68.5” D x 38” W
- Max speed of 2.0 MPH under default settings
- Warranty Information
 - Frame: Lifetime
 - Motor: 3 Years
 - Parts: 2 Years

Under the Desk Cycle

Why the under the desk cycle?

The desk cycle or pedal machine has been the subject of several studies, presenting the equipment as a strong worksite intervention method to combat the impacts of prolonged sitting. One study introduced a desk cycle intervention to full time employees who were working in sedentary occupations (15). The results of the study demonstrated that after approximately 20 minutes of use during an average of 12 days, over the course of 20 working days, participants reported a decrease in sedentary time (15). In addition, participants described the machines as easy to use. The findings from the study “suggest that



Suggested model: DeskCycle™ (16)

this pedal machine may be a feasible tool for reducing sedentary time” and can function as a light-intensity activity break, mitigating the effects of prolonged sitting time (15).

In addition, the DeskCycle™ design will allow for an easy retrofit to pre-existing furniture. The features of the pedal machine allow for easy adaption to diverse users (22).

Features (22):

- Uses magnetic resistance to ensure quiet operation.
- Bidirectional pedals—can pedal forwards or backwards.
- Adjustable resistance range allowing users to adjust to a comfortable setting.
- Low pedal height (10” at the highest point) allowing for comfortable under desk use.
- Wide solid base keeping the DeskCycle on the ground during use.

Specs (22):

- 10” H x 20” W x 24” D
- 8 resistance steps
- Warranty Information
 - 1 year warranty on parts and labor
- Maintenance: Bike shops can typically repair any damages and then owner can be reimbursed for the cost from supplier

Swopper® Chair

Why the Swopper chair?

The Swopper chair was designed for users who must sit for extended periods. However, the Swopper modifies prolonged sitting by requiring the user to engage in three-dimensional movement. Though this specific worksite intervention does not combat the effects of prolonged sitting through light-intensity physical activity, the Swopper mitigates health impacts continuously by turning a sedentary period into an “active sitting” period (18). In addition, users of the Swopper demonstrate a significant amount of posterior pelvic tilt, leading to negligible levels of lordosis (excessive inward curvature of the spine) (19). This can be very beneficial to students who are engaging in prolonged seating. In addition, including information on ideal posture can be a useful tool for students utilizing the Swopper chair to achieve optimal posture (19).

Further, the Swopper has additional benefits apart from fostering improved posture. The chair helps



Suggested model: Swopper® Classic (17)

strengthen core muscles, elevate static pressure on joints, and helps improve circulation (18).

In addition, according to Mann library data about student groups, in 2015, nearly half of all observed users were in groups of 2-4 people (23). The Swopper chair is ideal for individual use in dynamic group situations as it promotes mobility and tilting in (perhaps to a group table). Due to the level of group work ensuing in Mann library, this could be a useful tool in sponsoring collaboration.

Features (18):

- Able to adjust the height, tension and lateral condition.

Specs (18):

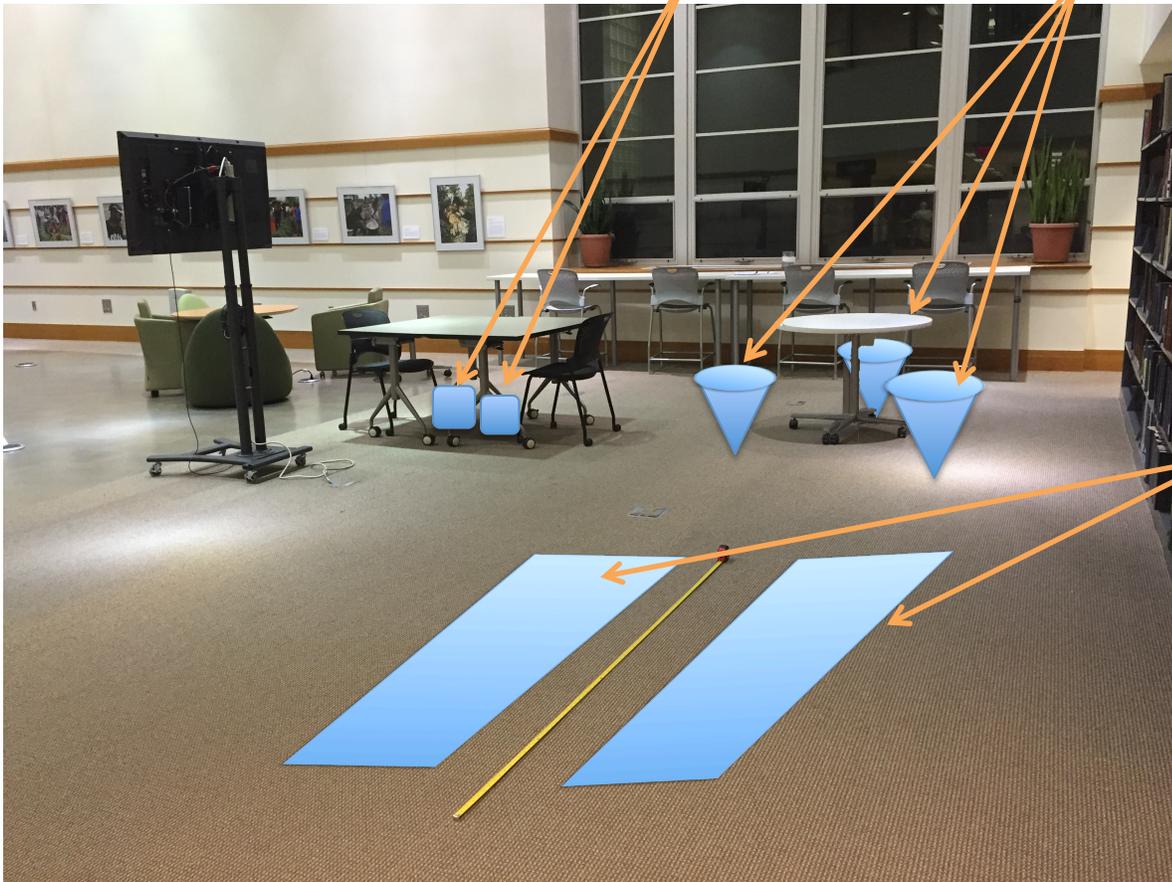
- 22-27.5" H x 21.5" W x 6" D
- Warranty Information
 - 5 year warranty with repairs and full replacement
- Maintenance: can be cleaned with soap and water

Spatial Planning

Mann Library Bissett Collaborative Center

Under the desk bikes

Swopper chairs



Treadmill desks

Budget

<i>Item</i>	<i>Amount</i>	<i>Cost</i>	<i>Purpose</i>
LifeSpan® TR1200-DT5	2	\$1,499.00 x 2 \$2,998.00	Treadmill desk
Nike Grind Exercise Equipment Mat	2	\$49.99 x 2 \$99.88	Protects flooring including carpeting and absorbs equipment vibration and noise (helps reduce maintenance)
DeskCycle™	2	\$159.00 x 2 \$ 318.00	Under desk cycle
Swopper™ Classic	3	\$699.00 x 3 \$ 2097.00	Active chair
			Total: \$5,512.88 + shipping/tax

References

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- (2) President's Council on Fitness, Sports & Nutrition (2012). Too Much Sitting: Health Risks of Sedentary Behavior and Opportunities for Change. *Research Digest*. Series 13 (3).
- (3) World Health Organization (2016). What is Moderate-intensity and Vigorous-intensity Physical Activity? *Global Strategy on Diet, Physical Activity & Health*.
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- (10) "Treadmill Workstations: The Effects of Walking while Working on Physical Activity and Work Performance" conducted by Ben-Ner et al. (Ben-Ner, A et al. 2014)
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- (16) Image retrieved from: <http://www.deskcycle.com/>
- (17) Image retrieved from: <https://lib.store.yahoo.net/lib/thehumansolution/via-swopper-desk-chair.jpg>
- (18) Swopper chair product information/manufacture page: <http://www.swopper.com/swopper-classic-1/>

(19) Annetts, S., Coales, P., Colville, R., Mistry, D., Moles, K., Thomas, B., & Van Deursen, R. (2012). A pilot investigation into the effects of different office chairs on spinal angles. *European Spine Journal*, 21(2), 165-170.

(20) Bloomberg, M.R. et al., (2010). Active Design Guidelines: promoting physical activity and health in design. Chapter 1: Environmental design and health: past and present, pp. 12-19.

(21) Treadmill workstation product information/manufacture page:
<http://www.lifespanfitness.com/tr1200-dt5-treadmill-desk>

(22) DeskCycle product information/manufacture page: <http://www.deskcycle.com/>

(23) Data retrieved from:
https://public.tableau.com/profile/camille.andrews#!/vizhome/MannLibrarySpaceUsage2014-5_0/StatsbyYear

Class Connections:

1. “Make it Active” from Urban Land Institute

In the report “Ten Principles for Building Healthy Places,” the Urban Land Institute lists number 10 “Make it Active”. This principal introduces the notion that physical activity is not incorporated into the design of everyday life, and our society could benefit from doing so. The report specifically suggests incorporating activity into urban planning. The intervention in this proposal builds upon the same principal—designing and incorporating activity into the design of everyday life. With students spending such a significant amount of time in libraries, unwilling to step away from their work, the worksite equipment recommended in this proposal is an example of trying to organically build activity opportunities into daily environments. In addition, the report by Urban Land Institute discusses “design for flexibility”. The intervention in this proposal also aims to be flexible, allowing students to select the equipment that best fits their needs, interests, and routine. As the texts suggests, maximization for human engagement should be a priority, and that is what this intervention sets out to accomplish.

Source: Eitler, T.W., McMahon, E.T., Thoerig, T.C. (2013). Ten principles for building healthy places. The Urban Land Institute.

2. Life Course Perspective

For some, hopefully this intervention will serve as a turning point (or at least transition), in the framework of the life course perspective. Many college students are on a trajectory towards an increasingly sedentary lifestyle associated negative health impacts. Beyond college, many students will take office work where they will continue the unhealthy cycle of prolonged sitting. This intervention will provide students with information and equipment necessary to catalyze a change in sedentary behavior patterns.

Source: Wethington, E. (2005). An overview of the life course perspective: Implications for health and nutrition. Journal of Nutrition Education and Behavior, 37 (3), 115-120.

3. Potential future application: Health Impact Assessment (HIA)

I would be very interested to conduct a Health Impact Assessment after the introduction of the activity facilitating equipment. An HIA would allow both the client (Mann library) and myself an opportunity to evaluate the impact of the project on the health and habits of the population. This information could be very valuable for future worksite interventions.

Source: Morris, M. (2006). Integrating Planning and Public Health: Tools and Strategies to create healthy places. Chapter 6: Health Impact Assessment. Pp. 73-80

4. See citation 20; Background information rooted in class discussion.

Source: Bloomberg, M.R. et al., (2010). Active Design Guidelines: promoting physical activity and health in design. Chapter 1: Environmental design and health: past and present, pp. 12-19.

Treadmill Workstation



Proper use



How to adjust

Why Use a Treadmill Workstation?

Combat the detrimental health impacts of prolonged sitting

In the short-term, prolonged sedentary behavior can lead to swollen ankles, strained neck, slowed mental function and sore shoulders and back (1). In addition, long-term impacts include muscle degeneration, increased risk of metabolic disease and even pre-mature mortality (1, 2). By using a treadmill workstation, you can mitigate the negative health impacts of prolonged sitting by engaging in a light-intensity activity (without compromising the time you have allotted to complete your work)! **Use this machine for approximately 30 minutes.** By doing this, not only will you counteract the negative health implications stemming from sedentary behavior but you will increase your circulation and your brain function!

Guidelines for Proper Use

Follow these guidelines to optimize your experience:

- Adjust the height of the desk until it is situated at a comfortable level.
- Operate the treadmill at a speed of 0-2 mph for approximately 30 minutes.
- TIP: If activity facilitating equipment isn't available, take a 10 minute walk approximately every 2 hours you are seated; this also helps counteract the impacts of sedentary behavior. While it is still important to regularly engage in moderate to vigorous-intensity exercise, the best way to mitigate the effects of prolonged sitting is to take frequent, light activity breaks.

Model: LifeSpan® TR1200-DT5

References:

- (1) Berkowitz, B., & Patterson, C. (Jan 2014) The Health Hazards of Sitting. *The Washington Post*.
- (2) President's Council on Fitness, Sports & Nutrition (2012) Too Much Sitting: Health Risks of Sedentary Behavior and Opportunities for Change. *Research Digest*. Series 13 (3).

Images retrieved from seller website.