Obesity

Treadmill Desks: A 1-Year Prospective Trial

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Objective: Sedentariness is associated with weight gain and obesity. A treadmill desk is the combination of a standing desk and a treadmill that allow employees to work while walking at low speed.

Design and Methods: The hypothesis was that a 1-year intervention with treadmill desks is associated with an increase in employee daily physical activity (summation of all activity per minute) and a decrease in daily sedentary time (zero activity). Employees ($n = 36$; 25 women, 11 men) with sedentary jobs (87 $\pm$ 27 kg, BMI 29 $\pm$ 7 kg/m^2, $n = 10$ Lean BMI < 25 kg/m^2, $n = 15$ Overweight $25 <$ BMI < 30 kg/m^2, $n = 11$ Obese BMI > 30 kg/m^2) volunteered to have their traditional desk replaced with a treadmill desk to promote physical activity for 1 year.

Results: Daily physical activity (using accelerometers), work performance, body composition, and blood variables were measured at Baseline and 6 and 12 months after the treadmill desk intervention. Subjects who used the treadmill desk increased daily physical activity from baseline 3,353 $\pm$ 1,802 activity units (AU)/day to, at 6 months, 4,460 $\pm$ 2,376 AU/day ($P < 0.001$), and at 12 months, 4,205 $\pm$ 2,238 AU/day ($P < 0.001$). Access to the treadmill desks was associated with significant decreases in daily sedentary time (zero activity) from at baseline 1,020 $\pm$ 75 min/day to, at 6 months, 929 $\pm$ 84 min/day ($P < 0.001$), and at 12 months, 978 $\pm$ 95 min/day ($P < 0.001$). For the whole group, weight loss averaged 1.4 $\pm$ 3.3 kg ($P < 0.05$). Weight loss for obese subjects was 2.3 $\pm$ 3.5 kg ($P < 0.03$). Access to the treadmill desks was associated with increased daily physical activity compared to traditional chair-based desks; their deployment was not associated with altered performance. For the 36 participants, fat mass did not change significantly, however, those who lost weight ($n = 22$) lost 3.4 $\pm$ 5.4 kg ($P < 0.001$) of fat mass. Weight loss was greatest in people with obesity.

Conclusions: Access to treadmill desks may improve the health of office workers without affecting work performance.

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Introduction

Obesity represents the combined effect of obesogenic environments and individual biological susceptibility; causative elements include sedentariness and food eaten in excess of need. Although obesity treatment has focused on individual solutions, less effort has been expended in environmental reengineering. This may be because environmental reengineering is multifaceted and involves architecture, furniture design, workflow innovation, and expense.

Evidence suggests that sedentariness is associated with a myriad of health complications, including heart disease, metabolic syndrome, and cancer, and is associated with premature mortality (1,2). These conditions are associated with higher insurance costs and losses in workplace performance (3). As a result, many corporations and their respective insurance providers are exploring relationships with health clubs and gyms that provide access, discounts, and monetary incentives for employees (4). However, such programs are not ubiquitous and poorly accessed by people, especially with obesity (5). The modern workplace fosters sedentariness (6) and people with obesity tend to sit more than lean individuals (7). Individuals move less at work than they do in leisure time (8). Moreover, there are benefits of intermittent bouts of walking to break-up sitting time (e.g., blood glucose) (9). Therefore, workplace reengineering to reverse sedentariness may be beneficial to employee health.

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One approach to workplace reengineering is to reexamine the *modus operandi* of the work desk. A treadmill desk (10) is a desk that enables an employee to walk on a treadmill while continuing normal work activities. Commercial units are available that include speed-restricted treadmills and a hydraulic desk top with an integrated treadmill control panel. Preliminary research examining treadmill desks (11) demonstrates that people can conduct normal office tasks (e.g., computer use and telephone calls) while walking on a treadmill desk at about 1 mph. In so doing, energy expenditure increases by 100–150 kcal/h and people, even with obesity, can tolerate this intervention for several hours per day (12). Access to treadmill desks might be useful to help people lose weight because many people work at desks for many hours each day. We were interested in whether changing a person's desk—without any specific behavioral intervention—could increase daily physical activity, decrease sedentariness, and improve body weight.

Subjects and Methods

Subjects

The 1-year study was conducted at Educational Credit Management Corporation (ECMC), a financial services corporation; in Oakdale, MN. Thirty-six office workers with sedentary job descriptions ("a job that requires sitting at a desk/table for the majority of the work day") were recruited. Any employee with a sedentary job at ECMC could volunteer for the trial; however, subjects were excluded if their personal physician advised them against the study, they were unable to walk at 3 mph for 30 min, or were pregnant. The company, ECMC, agreed to allow subjects to complete the 1-year treadmill desk intervention irrespective of potential negative workplace performance.

Protocol

We conducted a 1-year prospective trial to evaluate access to treadmill desks dedicated to a single employee in their workspace. Employees were not relocated due to the installation of the treadmill desk. We addressed the hypothesis that a 1-year intervention with access to treadmill desks was associated with increased employee daily physical activity, defined as the summation of low-, moderate-, and high-intensity physical activity (Clinicaltrials.gov; NCT01461382). Our secondary hypothesis was that a 1-year intervention with access to treadmill desks was associated with decreased employee daily sedentary time defined as time spent accumulating zero physical activity (as measured with an accelerometer). The Mayo Clinic Institutional Review Board approved the study and subjects provided informed written consent. All subject measurements were recorded in a private room.

Baseline period. A 2-week baseline period preceded the treadmill desk intervention. Over the two baseline weeks, the 36 subjects worked normally (seated) at their usual desk. Subjects underwent a 14-day measurement daily physical activity, duplicate measurements of body composition, assessment of workplace performance, and venous blood determination of glucose, insulin, Hemoglobin A1C, and lipids. Measurement techniques are detailed below.

12-Month treadmill desk intervention. A treadmill desk replaced each of the 36 participants' pre-existing desks for 12 months. One treadmill desk was dedicated to each individual. The employee's original (traditional) desk was removed. As noted above, personnel were not located. The treadmill desk we used (Steelcase, Grand Rapids, MI) was a desk that can be elevated or lowered using a hydraulic motor at the press of a button (Figure 1). The treadmill beneath the desk ran silently up to a maximum speed of 2 mph. The unit cost was ~$3,000–4,000 and was compliant with office safety standards. The treadmill desk, by design, did not compel the owner to walk because it could be lowered for chair use at the press of the button.

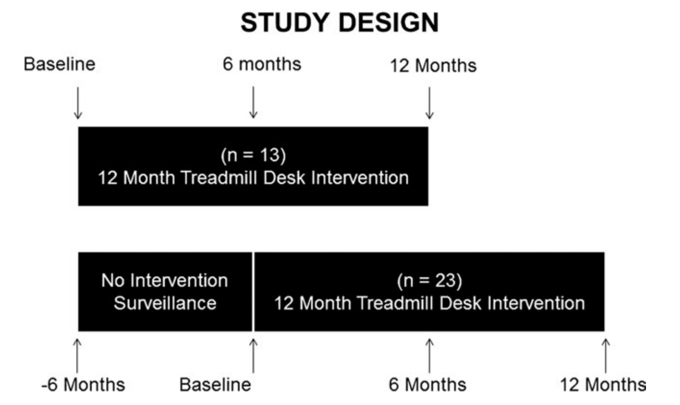

FIGURE 1 Study design of 36 office workers in a 1-year prospective trial of a treadmill desks intervention.

The baseline measurements of daily physical activity, daily sedentary time (minutes with no activity), body composition, venous blood, and workplace performance outcomes were repeated at 6 and 12 months of the intervention. The techniques are described below.

Measurement techniques. All measurements and study activities took place in a research laboratory that we built inside the ECMC facility. It was staffed daily by a member of the study team. The subjects were weighed on a calibrated scale (model 644, Seca Corporation, Hanover, MD). Height was measured using a standiometer (model 242, Seca Corporation).

Body composition was measured using air-displacement plethysmo graphy (Life Measurement Incorporated, Concord, CA) (13).

Daily physical activity was monitored during waking hours, 7 days a week, throughout the 1-year intervention using a belt-worn accelerometer (Actical; Respironics, Philips, Eindhoven, The Netherlands). To account for nonwear time, data were excluded for missed whole and/or partial days. The download process took about 1–2 min and does not interfere with work time. The actical used a lithium coin cell battery CR2025 and were changed approximately every 6 months by loosening four small screws on the back of the device. The battery changing process required about 2 min per device.

Venous blood was drawn a by nursing staff for measurements of glucose, HDL, LDL^{calculated}, total cholesterol, triglycerides, thyroid stimulating hormone (TSH), and hemoglobin A1C.

Duplicate resting blood pressure (after 30 min of rest) was measured using an automated cuff (HEM-711ACN, Omron, Bannockburn, IL).

Lying (resting), sitting, and walking energy expenditure were measured using indirect calorimetry (7). Subjects fasted for ≥10 h, had not undertaken vigorous activity for ≥6 h, had not consumed caffeine for >10 h nor alcohol for >12 h prior to the start of the measurements. Subjects were in thermal comfort (68–74°F). Subjects were allowed to drink water at room temperature and were encouraged to empty their bowel and bladder before the measurements. Energy expenditure was measured using indirect calorimetry while subjects were at lying rest (30 min), sitting in their office chair reading (15 min), and walking at 1, 2, and 3 mph each for 15 min.

Workplace performance was assessed by employees and their supervisors using validated surveys (14). The surveys addressed four aspects of workplace performance: overall performance, quality of work, quantity of work, and quality of interactions with coworkers. A weekly survey was administered on Wednesdays to all employees. The survey required ∼4 min to complete. Supervisors completed similarly structured weekly surveys that focused on their employees' workplace performance. A more detailed survey was administered every 3 months and took ∼20–30 min to complete (15,16). The weekly surveys focused on the week prior to the survey; the quarterly surveys asked employees and their supervisors about workplace performance during the prior 4 months.

Data and statistical analysis

Accelerations were gathered at 32 Hz, summated, time stamped, and stored each minute on the device internal memory. Data from the device were then downloaded once a week by the study team using a standard laptop. All values are provided as mean ± SD. ANOVA and post hoc paired *t*-tests were used to compare changes over time. Where indicated linear regression analysis was used. Statistical significance was defined as $P < 0.05$.

Results

Thirty-six subjects were recruited for the 1 year treadmill desk intervention; 25 women, 11 men; 42 ± 9.9 years, 87 ± 27 kg, and BMI 29 ± 7 kg/m^2 (Table 1). Ten subjects (9F:1M) were lean (BMI < 25 kg/m^2), 15 overweight (11F:1M) (25 < BMI < 30 kg/m^2), and 11 had obesity (5F:6M) (BMI > 30 kg/m^2). Four additional subjects were initially recruited but did not complete the study; one because of the diagnosis of inflammatory bowel disease, one because of pregnancy, one person developed connective disease requiring high dose steroid use, and one because the person left the company. The data from these four participants are not included in the analyses.

For the 36 subjects in general, it took <5 min to acclimate to the treadmill desks. There were no injuries or reportable events associated with use of the desks. The subjects tolerated the treadmill-based system well over the 1-year intervention.

To address our primary hypothesis, we compared daily physical activity at baseline and at 6 and 12 months. Subjects showed increased daily physical activity with the treadmill desk intervention. At baseline, the 36 subjects averaged 3,353 ± 1,802 activity units (AU)/day, at 6 months, 4,460 ± 2,376 AU/day ($P < 0.001$), and at 12 months, 4,205 ± 2,238 AU/day ($P < 0.001$) (Figure 2A).

Daily sedentary time (zero activity) was 1,020 ± 75 min/day at baseline and decreased with the treadmill desk intervention; after 6 months, daily sedentary time decreased by 91 ± 66 min/day to 929 ± 84 min/day; $P < 0.001$. At 12 months, the decrease in daily sedentary time was by 43 ± 67 min/day to 978 ± 95 min/day; $P < 0.001$ (Figure 2B).

TABLE 1 **Anthropometric, body composition, and metabolic variables at baseline and after 6 and 12 months in 36 subjects enrolled in the treadmill desk intervention**

	Baseline	6 Months	12 Months
Weight (kg)	86.9 ± 26.6	85.6 ± 26.4**	85.5 ± 25.8*
Body fat (%)	31.4 ± 7.9	31.8 ± 8.2	30.5 ± 8.6
Fat mass (kg)	28.4 ± 15.0	28.1 ± 13.9	27.0 ± 14.4
Fat free mass (kg)	59.3 ± 15.3	57.6 ± 15.4*	58.5 ± 14.9
Glucose (mg/dl)	93.8 ± 23.0	95.6 ± 36.3	92.7 ± 11.1
Hemoglobin A1c (%)	5.3 ± 0.9	5.5 ± 1.0***	5.5 ± 0.6
Total cholesterol (mg/dl)	193 ± 32	192 ± 34	193 ± 28
Triglycerides (mg/dl)	133 ± 88	124 ± 77	121 ± 57
HDL (mg/dl)	55 ± 20	55 ± 20	59 ± 23**
LDL (mg/dl)	112 ± 31	112 ± 29	107 ± 30
Waist Circ. (cm)	95 ± 19	92 ± 19***	91 ± 18***
Systolic BP (mm Hg)	132 ± 13	128 ± 14*	129 ± 13*
Diastolic BP (mm Hg)	89 ± 18	83 ± 8	84 ± 9

Data are shown as mean ± SD (comparisons to baseline).
*$P < 0.05$.
**$P < 0.01$.
***$P < 0.001$.

The increase in daily physical activity at 6 and 12 months occurred predominantly during the work day. We were able to access accelerometer data for treadmill walking at work; at baseline, walking was 70 ± 25 min/day; at 6 months, 128 ± 62 min/day ($P < 0.001$); and at 12 months, 109 ± 62 min/day ($P < 0.001$). Desk use itself, accounted for approximately ∼63% of the increased activity at 6 months and ∼90% of the increased activity at 12 months.

The treadmill desk intervention was not associated with altered workplace performance. Employee self-rated workplace performance assessments (Table 2) varied more than assessments by supervisors, but overall, the results are similar. There were no significant changes in employee workplace performance either as self-assessed or assessed by supervisors. The relationship between time spent working on the treadmill desk and several performance measures suggested that there was a minor loss in workplace performance for the first 3–5 months. However, by the end of the 1-year intervention, workplace performance exceeded baseline.

Interestingly, there was significant interindividual consistency in daily physical activity. There was a significant positive relationship for the 36 employees between daily physical activity at baseline and at 6 months ($r^2 = 0.58$; $P < 0.001$) and at 12 months ($r^2 = 0.52$; $P < 0.001$) of the intervention. Thus, interindividual variance was maintained even with the intervention.

Although this was not an *a priori* hypothesis, we examined the effect of season post hoc. There were 36 employees in the 1 year treadmill desk intervention. Thirteen employees started the treadmill desk intervention in May of 2008 and ended the intervention in May 2009. Twenty-three other employees started the 1 year treadmill

TABLE 2 Employee rated performance and supervisor rated performance at baseline, 6 and 12 months of the treadmill desk intervention

	Phase I Employees			Phase II Employees		
	Baseline	Δ6 months	Δ12 months	Baseline	Δ6 months	Δ12 months
Employee rated performance						
Overall	7.71 ± 0.96	−0.35 ± 0.19	−0.21 ± 0.20	7.32 ± 1.42	−0.25 ± 0.16	−0.05 ± 0.18
Quality	3.56 ± 0.39	−0.16 ± 0.07	0.02 ± 0.09	3.53 ± 0.46	−0.17 ± 0.07	−0.08 ± 0.08
Quantity	3.40 ± 0.41	−0.13 ± 0.08	0.10 ± 0.09	3.37 ± 0.38	−0.05 ± 0.06	0.15 ± 0.07
Interaction	3.54 ± 0.50	−0.12 ± 0.10	−0.02 ± 0.08	3.41 ± 0.40	−0.13 ± 0.07	−0.05 ± 0.07
Supervisor rated performance						
Overall	6.99 ± 1.21	−0.42 ± 0.20	−0.73 ± 0.15	7.54 ± 1.21	−0.42 ± 0.16	−0.37 ± 0.30
Quality	3.37 ± 0.48	−0.06 ± 0.09	−0.07 ± 0.07	3.70 ± 0.48	−0.15 ± 0.09	−0.04 ± 0.07
Quantity	3.23 ± 0.39	−0.06 ± 0.12	−0.07 ± 0.11	3.64 ± 0.42	−0.11 ± 0.11	−0.15 ± 0.11
Interaction	3.45 ± 0.52	−0.08 ± 0.10	−0.12 ± 0.16	3.40 ± 0.41	0.02 ± 0.09	0.10 ± 0.09

Industry standard surveys were used to address four aspects of workplace performance (14–16): overall performance, quality of work, quantity of work and, quality of interactions with coworkers. A weekly survey was administered on Wednesdays to all employees. Supervisors completed similarly structured weekly surveys that focused on their employees' workplace performance. Negative values represent a decline in performance.

desk intervention, 6 months later (starting in November of 2008 and finishing in November of 2009). Therefore, there was a 6-month period (May 2008 through November 2008) where 23 employees had entered the study but received no intervention. During the 6 months of surveillance, the 23 subjects showed no significant change in body weight from −6 months to baseline (82.8 ± 18.2 at −6 months versus 83.5 ± 19.4 kg at baseline).

Subjects starting in May showed higher baseline daily physical activity than subjects starting in November (4,252 ± 2,022 and 2,827 ± 1,400 AU/day, $P < 0.02$). However, there were no group by time interaction (i.e., the pattern of changes within group were similar between groups).

Weight loss occurred with the treadmill desk intervention, but for the group as a whole, it was modest. For the 36 participants, fat mass did not change significantly, however, those who lost weight ($n = 22$) lost 3.4 ± 5.4 kg ($P < 0.001$) of fat mass. At baseline, subjects weighed 86.3 ± 26.5 kg and after 12 months of intervention this decreased to 85.1 ± 25.6 kg ($P < 0.05$) (Table 1). There was variability in weight change over the 12-month intervention; weight change ranged from −9 kg to +4 kg.

High Responders to the intervention were defined as having increased daily physical activity by 100 AU/day at Month 12. High responders lost more weight than non-responders (4 ± 4 kg weight loss *versus* 1 ± 3 kg weight loss; $P < 0.05$). For the 22 subjects that lost weight, body fat decreased ($P < 0.001$). Body Composition data (17) (Table 1) that demonstrated fat loss at 12 months were 3.4 ± 5.4 kg. With the treadmill desk intervention, waist circumference significantly decreased for all subjects; 95 ± 19 cm *versus* 91 ± 18 cm ($P <$

FIGURE 2 Treadmill desk. Steelcase Walkstation in an Educational Credit Management Corporation employee cubical.

TABLE 3 Energy expenditure (kcal/h) and energy efficiency (kcal/kg/h) measured using indirect calorimetry at baseline and after 6 and 12 months in 36 subjects enrolled in the treadmill desk intervention

	Baseline	6 Months	12 Months
RMR (kcal/h)	70 ± 20	71 ± 24	73 ± 25
1 MPH (kcal/h)	176 ± 53	173 ± 63	166 ± 58
2 MPH (kcal/h)	241 ± 70	239 ± 79	236 ± 82
3 MPH (kcal/h)	313 ± 100	318 ± 111	315 ± 126
RMR (kcal/kg/h)	0.83 ± 0.19	0.83 ± 0.18	0.86 ± 0.14
Sitting (kcal/kg/h)	1.02 ± 0.23	0.97 ± 0.20	0.97 ± 0.18
1 MPH (kcal/kg/h)	2.06 ± 0.37	2.03 ± 0.37	1.94 ± 0.31
2 MPH (kcal/kg/h)	2.82 ± 0.46	2.81 ± 0.42	2.75 ± 0.38
3 MPH (kcal/kg/h)	3.66 ± 0.49	3.76 ± 0.55	3.63 ± 0.62

Data are shown as mean ± SD.

0.001). In subjects with obesity, waist circumference decreased from 101 ± 26 to 96 ± 25 cm ($P < 0.001$).

Employees with obesity lost more weight than lean subjects (2.3 ± 3.5 kg weight loss *versus* 0.7 ± 2.3 kg weight loss; $P = 0.04$). Employees with obesity significantly increased daily physical activity from baseline (3,672 ± 1,959 AU/day) to 6 months (4,960 ± 2,666 AU/day, $P < 0.01$) and continued to increase activity through 12 months (5,041 ± 2,383 AU/day, $P < 0.02$). Lean subjects significantly increased daily physical activity; from, at baseline, 3,897 ± 2,187 AU/day to, at 6 months, 4,713 ± 2,229 AU/day ($P < 0.05$). However, this increase was not sustained; at 12 months daily physical activity was 3,990 ± 2,513 AU/day (for decline, $P < 0.07$).

For the entire group, HDL increased over the 1-year intervention from baseline, 55 ± 20 mg/dl to 60 ± 23 mg/dl ($P < 0.005$). No significant whole group changes were observed in triglycerides, glucose, LDL, TSH, and total cholesterol. Similarly, energy expenditure sand energy efficiency did not change for the group as a whole (Table 3) over the 1-year intervention.

Discussion

Traditional chair-based desks were replaced with treadmill desks in 36 employees. We addressed the hypothesis that a 1-year intervention with access to treadmill desks was associated with increased employee daily physical activity. Our secondary hypothesis was that a 1-year intervention with access to treadmill desks was associated with decreased employee sedentariness. We found that with access to treadmill desks, employees' daily physical activity increased over the course of a year and sedentariness decreased. There was no significant change in workplace performance. Weight loss occurred, especially in subjects with obesity. Access to treadmill desks may help promote daily physical activity in chair-based office workers.

High income countries are battling sedentariness (18), overweight, obesity, and its health and fiscal consequences (19). The challenge of obesity extends into middle and low-income countries as well (20). Sedentariness is associated not only with obesity (1) but also with heart disease, diabetes, cerebrovascular diseases, cancer, and mood (18). One variable that determines sedentariness is job-type (21). This is especially important because most jobs in high income countries are screen based and sedentary (22). In addition, most people work for most of their waking hours and workdays are associated with more sedentary time than leisure days (8).

With respect to energy expenditure and obesity, active jobs can lead to energy expenditure of 2,000 kcal per day more than sedentary jobs (21). Furthermore, obese people are sedentary for approximately 2 h/day more than their lean counterparts (7).

The goal of the study was to examine the impact of transforming a traditional workspace (e.g., desk, chair, and computer) into an activity-promoting workspace (treadmill desk). We targeted a sedentary, computer-based, office environment because most Americans work in this manner (22,23). This type of work environment increases both screen time and seated time (24). One approach to increase office physical activity levels is through behavioral modification and improving access to health clubs (25–27). Another approach is to redesign the employees' physical workspace in such a way that physical activity is environmentally promoted (28). For instance, meeting rooms, printers, and trash cans can be placed distant from where employees work. Another approach for reversing workplace sedentariness might be to replace desk chairs with treadmill desks. In pilot studies, we found that people can conduct daily work tasks such as computer use and telephone calls while walking on a treadmill (11). However, these were pilot studies. Here, we evaluated access to treadmill desks in a prospective 1-year trial using objective outcome measures and workplace performance assessments. We found that access to treadmill desk use was associated with increased daily activity, decreased sedentariness, and unaltered workplace performance.

Although in this study, body weight decreased significantly, the average amount of weight loss was modest. This suggests that further efforts are needed to maximize the weight-associated health and cost benefits of active work. We suspect that a degree of compensatory eating occurred; maybe neurological mechanisms drove counter-regulatory responses to preserve body weight (29). Broadly, our observations are compatible with agricultural work studies which demonstrate that during peak harvest times, where physical activity increases, food intake increases as well (30). Thus, unless food intake is exogenously restricted with access to treadmill desks, weight loss cannot be maximized. Noting the degree of responsive compensatory eating that occurred with access to treadmill desks, we feel that future treadmill desk programs may incorporate programs of caloric restriction if the goal is to maximize weight loss (31).

The implementation of treadmill desks was associated with increases in daily physical activity throughout the year. Importantly, the initial 6-month effect was greater than the 12-month effect and suggests that the effect of the environmental change began to wane within a year, as occurs with other interventions. We also noted that the impact of access to treadmill desks on daily physical activity occurred regardless of seasonal effect although season impacted baseline activity (Spring activity levels were greater than Fall). Seasonal variance in daily physical activity is known to occur (32); the observation that the intervention impacted employees working indoors, regardless of seasonality, is noteworthy. The interindividual consistency of daily activity we found to be intriguing. This is not the first observation of this phenomenon (8). Beyond self-selecting for more sedentary jobs (33) which cannot be the case here, it may be that people with obesity have less ''appetite'' for activity not because of habitus but because of biological drives to enhance sedentariness and potentially conserve metabolic fuel (3).

While workplace performance was not affected significantly, the data suggested that there was an early adaptation response in the first 3 months, but thereafter employees adapted to the new work environment without impaired workplace performance. This is akin environmental interventions (34). Overall, with access to treadmill desks, workplace performance was unaffected.

Obese employees benefited from access to treadmill desks, significantly more than lean people with respect to weight loss. This may contrast with other workplace interventions where obese people tend not to use free or subsidized gym memberships as much as lean people (35).

With the degree of weight loss we found, the impact of access to treadmill desks may not seem to be cost effective. However, if a $3,000 desk helps prevent a person from developing diabetes, the costs saved from diabetes approximate, $10,000/person/year (36). Thus, deploying such approaches to targeted individuals may prove cost effective.

We recognize several limitations to this study. First, the treadmill desks were scattered throughout the workplace so that a treadmill desk employee sat next to a traditional seated desk user. Thus, we did not develop or support a ''micro-community'' of mutually supportive treadmill desk users; which might have increased daily activity further (37). Second, future interventions might benefit by embracing behavioral strategies to affect a sustained intervention (38). Third, this study was relatively short in duration. Thus, we feel that the next step is to link active work environments to sustainable behavioral programs (39), test these, and then proceed to longer term trials. Fourth, there were relatively few subjects in this study; this is important especially if we are suggesting that the walk-at-work approach may be widely applicable. Fifth, there was no control group matched for the entire intervention; for instance the Afternoon Dip we report (Figure 3) before the intervention began could have been anticipatory. It is, however, difficult to have a none-intervention control in a corporate setting over a year. Although we acknowledge this, we feel our conclusions are valid because the study was adequately powered to address our primary hypothesis and we were diligent to include a representative work population.

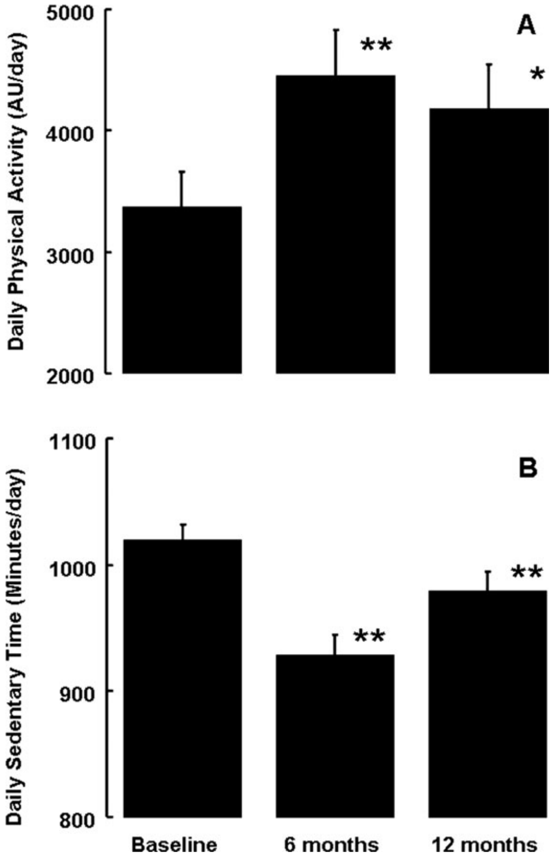

FIGURE 3 Daily physical activity (AU/day) (**A**) and daily sedentary time (min/day) (**B**) for 36 employees at baseline, 6 months, and 12 months after treadmill desk intervention. Comparisons to baseline, $^*P < 0.01$, $^{**}P < 0.001$. Data are shown as mean ± standard error.

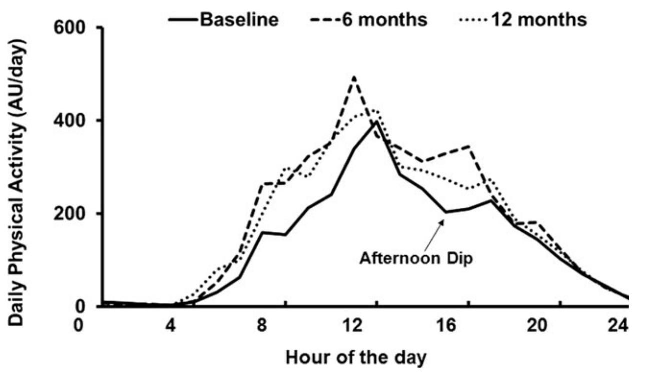

FIGURE 4 Hour-by-hour daily physical activity (AU/h) for 36 employees in a treadmill desk intervention at baseline, 6 months, and 12 months after treadmill desk intervention.

In conclusion, access to treadmill desks can help improve daily physical activity and reduce daily sedentary time.

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