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Primary Prevention of Weight Gain among New Bus Operators: Results of the Success & Health Impacts For Transit Operators during Onboarding (SHIFT Onboard) Pilot Study

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Abstract

Objective: To test the feasibility and efficacy of an enhanced onboarding intervention to prevent weight gain and support the early job success of new bus operators.

Methods: Control participants (n=9) completed usual practice new employee training and onboarding. Intervention participants (n=14) completed five supplemental trainings and four online challenges during their first year. Primary outcomes were body weight, dietary behaviors, physical activity, and sleep duration/quality. Early job success was evaluated with newcomer adjustment factors.

Results: The difference between intervention and control participants in body weight change at 12 months tenure was −6.71 lb (Cohen's d = −1.35). Differences in health behavior changes were mixed, but newcomer adjustment changes favored the intervention group.

Conclusions: Results support the feasibility of enhanced onboarding for bus operators to prevent worsening health while simultaneously advancing their success as new employees.

Keywords

onboarding; health intervention; bus operators; body weight; diet; physical activity; sleep; newcomer adjustment

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Conflicts of Interest: Oregon Health & Science University and Dr. Anger have a significant financial interest in Northwest Education Training and Assessment [or NwETA], a company that may have a commercial interest in the results of this research and technology (which was used in some studies reviewed in the current paper). This potential individual and institutional conflict of interest has been reviewed and managed by OHSU.

Ethical Considerations: The project was reviewed and approved by the Oregon Health & Science University Human Subjects Institutional Review Board (eirb protocol #20047). Human subjects provided written informed consent to participate in the study.

During the past century obesity has dramatically risen in incidence and prevalence among the U.S. population.[1, 2] Many factors at multiple levels of analysis contribute to an individual's risk for developing obesity, including their occupation. Workers in transportation and material moving occupations experience the highest prevalence of obesity in the U.S. (46.6%).[3] Within this occupational group, urban mass transit bus operators are exposed to a particularly challenging array of obesogenic conditions, including prolonged sitting; shiftwork; variable and long work hours; time-based, psychosocial, and traffic stressors; limited and/or unpredictable breaks; and limited access to healthy food options during work (if not brought from home). In a study based in the mid-western U.S., the obesity prevalence among a sample of bus operators was 58.00%.[4] Studies of objective body weight changes among bus operators during their first years on the job are lacking. However, in a retrospective survey study of bus operators, the reported average weight gain during their first year on the job was +7.67 lb.[5] In a review of over 50 years of research on well-being within the bus operator population, evidence indicated an elevated prevalence of health conditions associated with obesity, such as cardiovascular disease, hypertension, musculoskeletal symptoms, and gastrointestinal disorders.[6] Although evidence for elevated adverse health conditions among bus operators is abundant, intervention research is limited. This includes interventions to prevent or reduce obesity and its associated consequences.

According to the National Institute for Occupational Safety and Health's (NIOSH) Hierarchy of Controls, the top intervention priority, and most effective approach, is to eliminate hazardous working conditions.[7] NIOSH has recently applied the Hierarchy of Controls to *Total Worker Health*®[8] which is an approach that encourages an expanded view of occupational hazards that includes threats to physical health and well-being. In the Hierarchy of controls applied to *Total Worker Health*®, the priority and effectiveness of intervention approaches for addressing safety, health, and well-being hazards are ordered as: 1) Elimination, 2) Substitution, 3) Redesign, 4) Educate, and 5) Encourage. When hazards are present and cannot be fully eliminated or reduced through substitution or redesign of working conditions (e.g., sedentary work, shiftwork), employees should be educated about those hazards, as well as company policies, resources, and work practices to help them minimize exposures or mitigate impacts.

Employer communication and training about uncontrolled or poorly controlled hazards, as well as administrative or individual means to mitigate them, is a particularly important responsibility when employees are entering a new job or occupation. The initial training and socialization period, also known as onboarding, is also a time when employees' attitudes, knowledge, and practices are most malleable. New employees are learning about company policies and resources, observing workplace social norms, developing knowledge and skills to perform their work in a safe and healthy way, and establishing potentially long-lasting work habits. Effective onboarding practices are demonstrated to produce better job-related socialization adjustment and satisfaction for employees, and better performance and retention outcomes for employers.[9] While there is great potential to impact occupational health through onboarding practices, empirical evaluations of onboarding interventions are rare, and to our knowledge, none have strongly addressed employee health and well-being.

The present study piloted an enhanced onboarding intervention with new bus operators designed to support both their health and early job success. Enhanced activities were integrated with traditional new bus operator training processes. Intervention objectives included the primary prevention of weight gain, as well as improving indicators of successful socialization and performance within the company. This study is a component of a larger project that includes additional goals to (a) objectively measure the magnitude of the hazard of weight gain among new bus operators, as well as to (b) identify contributing and modifiable working conditions (e.g., particular schedules or schedule characteristics) that may be addressed through higher priority and more powerful controls to reduce the weight gain hazard.

Obesogenic Working Conditions for Bus Operators

As noted above, a number of bus operators' working conditions may contribute to the risk for developing obesity during employment. For example, operators can work up to 10-hour driving shifts,[10] where they are likely to be sitting for almost the entire duration.[11] Tight time constraints with limited or unpredictable breaks can prevent chances for physical activity bouts during the day. These same constraints can encourage a so-called "dashboard diet" that is focused on calorie dense and processed foods that are easily purchasable, portable, and can be eaten quickly.

Shiftwork can also influence operator health and body weight management via sleep disruption. Shiftwork does not have one specific definition, but generally refers to working hours outside of a traditional dayshift schedule (e.g., 9am-5pm). Shiftwork in general, and especially variability in shift types, can reduce overall sleep time, create circadian rhythm desynchronization, and increase sleep-related impairment.[12, 13] Sleep deficiency, which includes short sleep duration or poor quality, is associated with obesity and early mortality.[14, 15] This association is likely driven by the impact of sleep deficiency on metabolism[16], dietary behaviors, and physical activity. In order to meet the demand for public transit service, bus operators work a great variety of shift types and durations, including straight shifts (i.e., working a single contiguous shift of a predetermined length during the daytime), split shifts (i.e., working multiple separated shifts during a day based on rush hours), swing shifts (i.e., working solely from the afternoon through the evening or night), and extra board shifts (i.e., working variable hours and routes from day-to-day based on unscheduled operator absences). Operators typically bid for work assignments quarterly and have priority for choosing shifts based on seniority. Therefore, new bus operators with the least seniority typically bear the burden of some of the least desirable or variable shifts (e.g., earliest starting or latest ending shifts, split shifts, extra board).

Occupational stress is another exposure with negative health effects, including the potential to contribute to obesity. Occupational stress is associated chronic diseases such as coronary heart disease,[17] stroke, and type 2 diabetes.[18] Occupational stress is also strongly associated with insomnia,[19] and is thus indirectly associated with the health consequences of sleep deficiency (see above). Evidence for a direct relationship between stress and weight gain has been mixed, but this may be due to variable behavioral responses to stress (e.g., eating less vs. eating more). For example, in a five-year prospective study of workers in the

Whitehall II study,[20] an association between high job strain at baseline and weight gain five years later was observed, but only for men who were overweight at baseline (not for men who were leaner at baseline, and no stress-weight change relationship was seen for women). Examples of workplace stressors for operators include time pressure (e.g., strict schedule start times, running late or early, insufficient breaks), interpersonal conflict (with coworkers and passengers), and work-family conflict. New bus operators may experience a multitude of additional work stressors and stress responses, such as anxiety about learning and performance, meeting and getting along with new people, and ambiguity about their new role and expectations.[9, 21] As noted above, the schedules available to new operators (early mornings, evenings, weekends, split shifts) are likely to generate additional stressors, including work-family conflict and challenges for maintaining healthy eating and exercise habits. Choi et al.[22] proposed a socioecological framework for research on work and obesity among bus operators that focused on an overall imbalance between work demands/stressors and typical occupational resources available to bus operators. The authors suggest that this stress-resource imbalance is associated with chronic strain, poor health behaviors, and injuries or chronic pain, which in turn lead to hypothalamic dysfunction and obesity.

Why Onboarding?

Onboarding is a critical and limited period of time for employees where they are oriented to a new workplace and develop functional skills to succeed in their new position. As noted in sections above, employers have a critical responsibility during this time period to inform newcomers about poorly controlled hazards, and to provide methods and resources to mitigate such hazards. Intervening during this transition phase has the potential to produce unique and long-lasting effects on a range of performance, safety, health, and well-being outcomes. As new workers are adjusting to new routines and demands, they are also establishing their approach to work and work-related health habits.[23] During onboarding employers may apply an array of organizational socialization tactics to help new employees adjust, learn their job roles and skills, and achieve better practical outcomes on the job. In a meta-analysis of 70 non-intervention studies with new employees (within their first year of hire), Bauer et al.[9] found that newcomer adjustment factors of role clarity, self-efficacy, and social acceptance was associated with higher job performance, job satisfaction, and lower turnover rates. However, it is unknown the extent to which these variables relate to employee health, well-being, and stress, with the latter being quite salient during onboarding.[24] Additionally, it is unknown to what extent various approaches to onboarding may improve these newcomer adjustment factors.

Cable et al.,[25] as a single example of a controlled onboarding intervention study, found that new employees at a call center in India had significant improvements in job satisfaction and turnover (compared to a control) as a result of an enhanced onboarding group socialization intervention. Another onboarding intervention study (uncontrolled) at a hospital in Washington DC focused on improving communication with and support from managers and colleagues.[26] In a pre- and post-program analysis, this enhancement was found to reduce new-hire turnover by 20.70%. Onboarding-based interventions have the potential to positively impact new employees in a variety of ways, but empirical evidence from controlled intervention studies is limited.

Previous Body Weight Management Intervention Work with Bus Operators.

Although obesity and its health consequences are a concern in the mass transit industry, few health-related interventions have been evaluated with bus operators. Prior health interventions have reduced operators' pain, improved muscular endurance and flexibility, and improved dietary behaviors.[27–29] Body weight management interventions with bus operators have met with mixed success. A strength training intervention was evaluated in a randomized controlled trial with Brazilian transit drivers (n=96) with average Body Mass Indices in the normal (intervention group) or slightly overweight (control group) range. Investigators found that 24 weeks of resistance training significantly reduced drivers' body fat by 2.3% within the intervention group compared to the control group. [29] Body weight remained relatively stable across both groups. In a multi-case cohort study of Danish transit drivers (n=2,660), leaders at 20 garages selected from a pool of 116 interventions, including lifestyle and body weight programs which were implemented over an approximate 3 year period.[28] Although lifestyle behaviors improved, the proportion of obese drivers increased by the end of the study. Finally, in a randomized controlled trial with four garages at one transit authority in the U.S. (n=1,063), French et al.[27] implemented a broad range of health interventions (e.g., fitness center and vending machine improvements, health expos, farmers' markets, self-weighing team competitions, peer mentoring). This project was ambitious and notable for attempting to improve body weight management and reduce obesity among all operators at two randomly selected worksites. However, meaningful cross-contamination took place between intervention and control garages. Investigators observed a significant improvement in fruit and vegetable consumption at intervention garages compared to controls, but they did not observe a significant between conditions effect on body weight. To our knowledge, no prior study has intervened with new bus operators specifically, or integrated a preventive health or body weight management program with typical onboarding processes. We are also unaware of any onboarding studies in the general literature with an integrated health-focused component.

Given the lack of body weight effects from previous interventions for bus operators,[22] continued experimentation with additional or adjusted approaches are needed. A handful of more effective body weight management interventions developed for commercial truck drivers suggest that tactics such as health coaching, self-monitoring, social accountability, training, and online challenges with incentives may be both accepted and effective approaches.[30–32]These interventions produced mean within or between groups weight loss effects ranging from −3.18 to −3.86 kg (the Thiese et al. intervention produced a 3.2 kg median decrease). The current project represents a research extension of the Olson et al.[30] project. As such, elements of that intervention most directly informed the current project and its approach.

Addressing the Research Gaps

There are three primary gaps in the present literature that we aimed to address. First, bus operators, though working in known obesogenic conditions, have been rarely studied with occupational health interventions. Second, the most relevant health promotion intervention for bus operators[27] was notably ambitious in breadth and number of components; however,

it was not effective at impacting body weight, leaving room for improvements in addressing this outcome. Third, previous body weight management interventions for commercial drivers have focused on experienced employees rather than targeting new hires, who should be alerted to poorly controlled health-related hazards of their new job and employer-based and individual means to mitigate adverse effects of those hazards. The onboarding period may be a critical period where operators' work- and health-related practices may be strongly influenced via intervention.

Building upon our prior body weight management intervention research with truck drivers,[30] we developed an enhanced onboarding intervention to prevent weight gain and support the onboarding success of new bus operators. The resulting intervention was named "Success & Health Impacts For Transit operators during Onboarding" (SHIFT Onboard). The current intervention pilot study was designed to evaluate the feasibility of the approach and estimate effect sizes for targeted outcomes. Our primary outcomes included changes in weight, dietary behaviors, physical activity, and sleep (duration and quality). Our secondary outcomes included changes in newcomer adjustment, including role clarity, role conflict, self-efficacy, social connectedness, job satisfaction, and stress.[9]

METHOD

Participants and Procedures

Two public transit authorities in the Pacific Northwest region of the U.S. participated in the project. The organizations served similar sized metropolitan areas and each employed about 100 bus operators. At the intervention site all new operators were exposed to the enhanced onboarding intervention, but participation in study data collection was voluntary. Intervention operators participated in an informed consent process during their first week on the job. Those who volunteered to participate in study data collection completed the enrollment process and first set of study measurements. At the control site the process was similar, but due to the timing of the organization joining the study, the recruitment happened about 3 months after operators had been hired. Twenty-three of 40 new bus operators who were hired across the two sites (57.50%) enrolled in study data collection (intervention n=14; control n=9). At the intervention site the enhanced onboarding and study data collections were implemented with two classes of new hires. At the control site the study data collections were implemented with a single class of new hires.

Of the operators recruited at baseline, 17 (73.91%) remained through the final visit. All six participants who dropped out of the study were located at the intervention site. Two participants (one intervention and one control) missed at least one data collection visit, though remained enrolled in the study. One intervention participant who remained enrolled throughout the study was excluded from analyses because of a prolonged illness, unrelated to study participation, which impacted their body weight. See Table 1 for demographic and work characteristics of the 23 participants enrolled at baseline.

A between-groups repeated measures design was employed. Operators completed up to five study visits with researchers approximately every 3-4 months during their first year of employment. Originally only four visits were planned; however, due to control participants'

baseline occurring three months into their employment, as well as a study disruption due to the COVID-19 pandemic, we added a fifth visit for intervention participants in order to further assess tenure-aligned intervention effects. Therefore, study visit time points available for between groups comparisons occurred at approximately 3-months, 6-months, 9-months, and 12-months tenure. The study ran from July 2019 to November 2021. All procedures were approved by the institutional review board for human subjects research at Oregon Health & Science University.

Intervention Development and Description

The intervention design was guided by input from industry and labor partners, interviews with new and experienced bus operators, the research literature on bus operator health and new employee socialization, previous effective interventions for commercial truck drivers, and subject matter expertise of the scientific team. Intervention development involved creating an overall conceptual approach and schedule, lesson plans and activities for group training sessions, resource books for each group training session, a website application to support online challenges, and online training topics to be integrated into each challenge. The scientific team, staff members, and a contractor with expertise in motivational interviewing worked together as a group and within sub-groups to iteratively develop each component. Each component was assigned a lead developer who created plans and draft content, and then team members reviewed that material, discussed it, and provided collaborative feedback and input on improvements. Group training sessions and resource book materials were pilot tested with school bus operators and revised based on feedback. Initial plans for the website application were developed by the scientific team, collaboratively revised with and then programmed by the Oregon Clinical and Translational Research Institute at Oregon Health & Science University.

The intervention conceptual approach was structured around job success and health success factors. Body weight was described as a meaningful indicator of overall health, with four primary contributing factors of eating, exercise, sleep, and stress management. Job performance (safety, schedule, service, and satisfaction) was described as a meaningful indicator of overall job success, with four primary contributing factors of clarity, compliance, connection, and coping. While learning about and working to accomplish goals related to health and job success factors, intervention materials on each topic encouraged operators to be proactive in seeking resources and social support to achieve their goals.

The enhanced onboarding intervention was integrated with existing new bus operator training and onboarding processes. The intervention added five group training sessions (2 hours each) and four associated online challenges with incentives. Training sessions and challenges were designed to communicate information about job hazards and opportunities, provide education on targeted topics, build motivation for setting and working on health and job-related goals, and facilitate self-monitoring and feedback processes (individual and group-level). The first two group training sessions and first challenge were integrated into operators' initial training period before they went into service. The remaining group training sessions and challenges occurred after operators were in service. See Table 2 for an overview of intervention elements and when they occurred.

Group training sessions were designed to generate opportunities for trainers to apply the spirit, principles, and skills of motivational interviewing, and were facilitated by staff and contractors with training and expertise in motivational interviewing. Sessions were also designed to convey essential information, as well as to facilitate operators' social support for each one another, such as celebrating one another's goal progress, sharing tips for success, and sharing things learned on the job or from online training. Each session was planned to last 2 hours and included educational information, exploratory and motivation building activities (where trainers could employ motivational interviewing techniques with the group), an introduction to the next online challenge, and logging into the website to set goals and start the challenge. An example activity was called "My Vision for Success in my First Year," which was completed during the first training session. The Vision for Success activity asked each operator to reflect individually on job, health, and life outcomes they wanted to achieve by the end of their first year. Trainers provided some examples in each area. Operators then shared and discussed their visions with the group. During the group discussion for this activity trainers asked questions to help operators get specific about their desired outcomes, and explored operators' reasons and motivations for achieving those outcomes.

Online challenges were implemented with a website application developed for the project by the Oregon Clinical and Translational Research Institute. The website's main functions were a landing page to view individual and group visual feedback, a tracking page to input weekly logs, a page to view incentives and medals earned, and a training page to select and complete training. Operators were assigned a username and given a temporary password or login token, and then created their own strong password to access the website. For each challenge, operators selected a body weight management goal and behavioral goals from menus of options. Body weight goal options were to stay the same, lose 5 lb, or lose 10 lb. Example health behavior goals for selection in each domain included eating 5+ servings of fruit and vegetables daily (diet), 10+ minutes of physical activity (exercise), getting 7-8 hours of sleep each night (sleep), and mindful yoga/stretching (stress coping). Operators also self-monitored and reported weekly proactive actions they took related to each of the four domains of job success. Examples included: sought performance feedback from a supervisor (clarity), read/reviewed part of the training manual (compliance), had lunch with a coworker (connection), and noticed something positive at work (coping). The number and topics of online training modules varied for each challenge and are described in Table 2). Financial incentives and challenge medals were provided to motivate participation in tracking and training (see Table 2). Incentives were made dependent on participation (and not outcomes) to encourage accurate self-monitoring, but primarily because participation in a similar prior intervention process was associated with substantially better weight loss outcomes among truck drivers.[33]

Measures

Demographic and Work Characteristics—At baseline, operators were surveyed on their demographic (e.g., sex, age, race, education) and work characteristics (e.g., shift types, work hours). Shift types for bus operators were categorized as fixed route (i.e., driving the same routes every day), extra board (i.e., variable schedule, filling in for absent operators),

and paratransit (i.e., shorter buses that provide pickups and drop-offs at locations other than bus stops), as well as the percentage of shiftwork hours (e.g., hours worked outside of 9am to 5pm). Participants also reported the presence or absence of chronic health conditions (e.g., diabetes, high blood pressure).

Intervention Process Measures—Process measures for the intervention group included the number of weekly tracking submissions, number of training topics completed, pre- and post-training knowledge test scores, and challenge medals earned. We additionally conducted interviews with intervention participants and reviewed their qualitative evaluations of the program.

Primary Outcomes—Primary outcomes were body weight, diet, physical activity, and sleep (duration, quality/efficiency). Body weight was measured directly at the majority of study visits (TBF-310GS total body composition analyzer, Tanita, Arlington Heights, IL). However, due to University and employer restrictions related to COVID-19, participants self-weighed and submitted pictures of their current weight readings at Visit 4 for intervention cohort 1, and Visit 3 for intervention cohort 2 and control participants. Intervention participants used personal scales for those visits, and control participants used a study Tanita, which was left at the garage. Survey measures of behaviors included the frequency of consumption high fat and high sugar foods,[34] how often meals were brought from home,[34] and daily servings of fruits and vegetables.[35] Physical activity was measured with the International Physical Activity Questionnaire.[36, 37] Sleep duration and quality were measured using items 4 and 6, respectively, from the Pittsburgh Sleep Quality Index.[38]

Following each visit participants were asked to wear two Actigraph accelerometers (wGT3X-BT, ActiGraph, Pensacola, FL) to collect a 7-day sample of objective physical activity, sleep duration, and sleep efficiency data. Physical activity was measured with a hip-worn device, and sleep outcomes were assessed with a wrist-worn device. During this period participants also completed a daily sleep diary to record bed and wake times. Wear time validation for hip-worn devices was completed using a validated algorithm,[39] and to be included in analyses, a sample was required to have 4 or more days with at least 10 hours of wear time per day. Physical activity was quantified using Freedson activity bouts,[40] which are moderate-to-vigorous intensity bouts of physical activity lasting at least 10 minutes. We assessed both the average number of bouts and average time spent in the bouts per week. Sleep actigraphy data for valid days were processed and scored using a study-specific protocol modeled on our prior studies. Rest intervals were set manually by a research assistant based on criteria set for activity levels, light levels, and reported bed and wake times from diaries. A second research assistant double-scored the first 5 days of a random selection of 10% of the records scored by the primary rater. Interrater reliability for rest interval onsets and offsets was 96.68% ([agreements/disagreements + agreements]*100), with a disagreement defined as a time difference of 16 minutes. Only main sleep periods (i.e., a rest interval lasting 3 hours or more) were considered for analysis (not naps), and the two main variables of interest were sleep duration and sleep efficiency. The Cole-Kripke algorithm was selected for determining sleep and wake intervals during these main sleep periods.[41]

Secondary Outcomes—Secondary outcomes included newcomer adjustment variables that were measured with validated self-report scales assessing role clarity,[42] social connection,[43] self-efficacy,[44] job satisfaction,[45] and general work stress.[46]

RESULTS

Demographics

See Table 1 for a statistical description of bus operators' demographics and reported health conditions. Reported weekly work hours, as well as the percent of work hours outside of 9am-5pm, are also reported in the table based on operators' assignments reported at about 3 months on the job. The total sample was middle-aged (*M*=47.56 yrs), predominantly white (65.22%), and majority male (56.52%). However, the groups differed to a meaningful degree in race/ethnicity and sex, with the intervention group having more racial diversity and the control group being predominantly female. Most of the participants were married or living with a partner, and half had dependent children living in their household. Similar levels of education were present in each condition, with the majority reporting some level of college or technical school (but no degree). Reported diabetes or high cholesterol were rare conditions in the sample, however, about a third reported high blood pressure or had elevated risk for obstructive sleep apnea. In addition, a majority of participants reported being comfortable using technology (60.87%), and all reported using the Internet at least weekly.

Work characteristics are reported in Table 1 based on the 3-month tenure time point for both groups. Reported work hours per week for the total sample averaged 43.85 (*SD*=4.86) and were highly similar for both groups. The percentage of hours worked outside of 9am to 5pm (shiftwork) averaged 53.90% for the total sample, but was slightly higher in the control group. Route assignments were very different across groups, with intervention participants predominantly working the extra board (72.73%) and control participants predominantly working fixed routes (85.71%).

Intervention Process Results—As indicated above, all operators at the intervention site were exposed to the intervention. Data related to participation in online challenges was limited only to those who enrolled in the study component and provided informed consent to use their online data for research purposes. Study participants submitted weekly tracking data on an average of 19.62 weeks (*SD*=12.92) out of a possible 40-41 weeks (the second cohort had an extra week for their website warmup); this represents completion of 48.5% (*SD*=32.01%) of possible tracking submissions. Participants completed an average of 7.31 online trainings (*SD*=4.80) out of a possible 16. For training topics with available pre- and post-test data, the average within person improvement in test scores was +14.97% (*SD*=19.36%). The average pre-test knowledge score was 81.55% (*SD*=20.66%), and the average post-test scores was 96.52% (*SD*=14.63%). A total of 37 challenge medals were awarded to study participants over the course of the study, roughly half of which were gold (17; 48.65%). The average number total medals awarded per participant was 2.85 (*SD*=1.63; See Table 3 for a summary of medal incentives earned).

Qualitative interviews (n=14) were conducted with participants at the intervention site at follow-up visits (two operators contributed two interviews each). Interviews were video-recorded (n=11) or summarized with live notes (n=3). Recordings and notes were reviewed and summarized by a research assistant using structured notes aligned with each interview question.

There were seven core questions, with an additional twelve that were asked as time permitted. The first two were 5-point Likert-style ratings (5=best) of whether participants liked the program and whether they found it useful. For those asked these questions, ratings averaged 4.63 (SD=0.52; n=8) and 4.60 (SD=0.55; n=5), respectively. The remaining five questions focused on most useful/favorite and least useful/least favorite aspects of the program, as well as recommendations for changes or improvements.

The most common responses to useful aspects of the intervention related to themes of increased awareness and accountability (e.g., goal setting, weekly tracking). Other useful/favorite aspects reported by multiple operators related to social interactions, including getting together with peers for SHIFT training and being encouraged to make social connections at work. Additional factors seen as valuable included working on small habits that added up for big impacts and being encouraged to seek feedback from supervisors. The only *study* activity mentioned as being useful or favorite was the health checks with feedback. For questions related to opportunities for improvement, operators reported that it was difficult to remember to track or do the "weekly stuff." One operator suggested automated reminders would be helpful (others reported setting their own reminders); another suggested increasing incentives for the training to facilitate completion. One operator reported not liking some of the online trainings (without specifying which topics); another shared that they would like smartphone accessibility for the online training. Wearing actigraphs and surveys were reported as least favorite study activities by some. Operators were frustrated with survey questions that seemed irrelevant to the classroom phase of their training, were redundant or repetitive, and didn't reflect major pandemic impacts that occurred in April 2020.

Primary Outcomes—Mean differences and effect sizes were calculated to estimate intervention effects. The reported Cohen's d statistics utilized may be interpreted as being small (d≥0.20), moderate (d≥0.50), or large (d≥0.80) in size.[47] Due to the enrollment delay for control participants, absolute intervention effects were calculated by assessing the difference in change between visits where job tenure was comparable across groups (see Table 4). Thus, the functional "baseline" for each group was the 3-month tenure time point, which was compared to each subsequent visit. For ease of interpretation, we focus our discussion on the 12-month effects (i.e., the pairwise differences between the 3-month baseline and the 12-month final time point).

Pairwise deletion was used to maximize data use over time (i.e., participants' data were included if they had data at both visits used in the specific difference test, regardless of if they remained throughout the entire study or had missing data at other visits). Effect sizes were estimated using the pooled standard deviations of the mean differences with the following equation (EQ1).

$$d = \frac{MD_{Int} - MD_{Con}}{\sqrt{\frac{(N_{Int}-1)SD_{Int}^2 + (N_{Con}-1)SD_{Con}^2}{N_{Int}+N_{Con}+2}}} \quad \text{(EQ1)}$$

Where d is the absolute intervention effect. MD is the mean difference from the 3-month baseline for each respective condition (Int = Intervention; Con = Control). N is the number of participants with pairwise difference scores within each respective condition. SD is the standard deviation of the mean difference within each respective condition.

The 12-month absolute intervention effects for mean changes in weight was −6.71 lb (d=−1.35). This effect arose from different linear trends in body weight between conditions, such that weight remained flat or decreased over time for intervention participants, whereas weight generally increased across tenure for control participants (see Figure 1). Past research showed that participation levels in weekly behavior tracking in a mobile health intervention were associated with better body weight management outcomes for commercial drivers.[33] Although our final intervention group sample was small, there was a modest association (r=−0.24) between the proportion of website tracking submissions made and better weight change results.

Patterns in group differences in self-reported changes to diet, physical activity, and sleep were somewhat mixed (see Table 4). The absolute 12-month intervention effect on fruit and vegetable consumption indicated moderately worse intake compared to controls (d=−0.61). Sugary drink, sugary snack, and fast food consumption tended to decrease in both groups by the 12-month visit, but the observed decreases were generally larger for controls (absolute intervention effects ranged between +0.40-0.46). Intervention participants' meals brought from home, in contrast, had notably larger small, but substantial, increases in frequency compared to the controls at 12 months (d=+0.38). Self-reported physical activity changes were small to moderately higher among the intervention group compared to controls at the 12-month time point ($d_{Moderate}$=+0.22; $d_{Vigorous}$=+0.54). Similarly, self-reported sleep duration and sleep quality improved more for intervention participants than control participants ($d_{Duration}$=+0.60; $d_{Quality}$=−0.64[1]).

Actigraphy results generally aligned with participants' self-reported results. The absolute intervention effects for the number of Freedson bouts (d=+0.21) and time in bouts (d=+0.39) per week at the 12 month time point favored the intervention group. In raw terms, the absolute effects were +0.54 Freedson bouts and +14.69 minutes of exercise per week for intervention participants compared to controls. Sleep duration (d=+1.00) and efficiency (d=+0.52) increased substantially more in the intervention group than the control group at the 12-month time point. In raw terms, the absolute effects for sleep per main sleep period were +1.99 hours in duration and +13.22% efficiency for intervention participants compared to controls at the 12-month time point.

[1]Sleep quality is measured on a scale from 0-Very good to 3-Very Bad, so decreases indicate improved sleep quality.

Secondary Outcomes—Newcomer adjustment outcomes generally supported the intervention's efficacy. Role clarity was similar across groups at 12-months (d=−0.12). However, moderate-to-large absolute intervention effects were observed for social connection (d=+0.71), self-efficacy (d=+0.71), job satisfaction (d=+1.26), and general work stress (d=−1.13).

DISCUSSION

The primary purpose of the present study was to pilot an enhanced health and job success onboarding intervention with new bus operators, and estimate its effect sizes for targeted outcomes. The statistically significant and large difference (d=−1.35) in weight changes observed across groups at 12-months suggests that the intervention may be effective for the primary prevention of weight gain. The particular contrast in trends reflected an increase in weight for operators at the control site, and a zero-trend (weight gain prevention) among operators at the intervention site. The 12-month effect of −6.71 lb is also a level at which operators would experience reduced risk for developing high blood pressure and/or diabetes.[48,49] Effects for dietary behaviors were mixed, but physical activity, sleep, and newcomer adjustment factors were mostly positively and strongly affected by the intervention.

Enhanced onboarding activities proved to be feasible, and were integrated well with operators' usual onboarding processes and first year on the job. Exposure to planned intervention activities was high for in-person training sessions, but more modest for participation in online challenges (e.g., weekly tracking and online training). The online training topics, when completed, were effective for producing learning, with knowledge gains that were about +15% on average. Based on past research with commercial truck drivers demonstrating the benefits of higher participation,[33] future replications and extensions of the current project may benefit from experimenting with ways to increase participation levels in the online challenges.

This study, and the results observed, address important gaps in the literature. The primary gap addressed was evaluating a health and job success-focused onboarding intervention with workers entering an occupation with difficult-to-control obesogenic working conditions. A previous multi-component intervention for experienced bus operators produced significant effects for health behaviors, but did not influence operators' body weights.[27–29] Our intervention produced an encouraging primary prevention effect on objective body weight changes among bus operators during their first year of employment. A future planned randomized controlled trial, informed by the present study, will provide more conclusive evidence on the effectiveness of the intervention.

Strengths and Limitations

Core strengths of the study were its primary prevention approach, as well as the integration of intervention activities into existing new employee onboarding processes. The integration of health-related content with traditional onboarding is novel, and may present an important and powerful occupational health intervention strategy. The enhanced onboarding program was also strategically designed to simultaneously address both bus operator job success and

health. This strategy may help employers better achieve their traditional goals of onboarding (e.g., socialization, high job performance and satisfaction) with newcomers while also preventing salient health-related problems. The intervention was also evidence-informed, as it addressed socialization factors identified as being important for new employees in a prior meta-analysis, and also included elements and strategies from prior effective interventions for commercial drivers. The intervention also successfully maintained a high level of attendance at in-person training sessions during the first year on the job, as well as a degree of engagement in online challenges for this long period of time. The intervention was also tailored to, and evaluated with, an understudied population in high need. And finally, the inclusion of a control group at a similar sized transit authority in the same region was a critical strength. A zero-trend in body weight changes at the intervention site, during a time when the COVID-19 pandemic disrupted transit authority operations and bus operators' jobs, would have been difficult to interpret without the parallel observation of weight gain at the control site.

Limitations include the non-randomized design, lack of a true baseline for controls (i.e., at their hire date), missing systematic measurement of in-person attendance, and moderate attrition at the intervention site. Although the control group was very useful for a number of reasons (described more below), conditions were not randomized. Also, study participation at intervention and control sites were not yoked perfectly in time (start and end dates were different across sites). As such, effects found may be due in part to potential confounds such as state-level or organizational-level differences in policies, procedures, or culture; or seasonal differences. Additionally, we calculated intervention effects by aligning visits based on tenure at the time of measurement. Although we added an additional data collection point for intervention participants (Visit 5) in order to have comparison periods at 12 months tenure for both groups, the lack of a true baseline for control participants is a blind spot for the full pattern of changes in primary and secondary outcomes for those operators. We also did not systematically collect data on attendance to in-person training sessions, so the level of exposure to the in-person aspects of the intervention are unknown. Future work should systematically collect attendance data for in-person sessions (e.g., having participants sign attendance sheets for each class).

Volunteerism and attrition rates may relate to the interpretation of results. While the overall volunteerism to participate in research was relatively high (23 of 40 eligible operators consented), those who volunteered are likely to be different from those who did not in important ways. Also, a lower percentage of eligible operators volunteered at the intervention site, and that site also experienced study attrition while the control site did not. Five intervention site participants dropped out; two left because they were no longer employed, but three (~21%) actively withdrew (reporting they were too busy, lost interest, or gave no reason). Overall, it may be that the final intervention sample was comprised of the most conscientious and interested new operators at that worksite. This may have been true also at the control site, but to a lesser degree. Future research should experiment with ways to reduce total study participation burden for intervention participants. Potential factors to adjust could include the number of in person study visits and total measures collected.

Although anecdotally in-person training attendance was reported by study staff to be very high, participation rates in online challenges were modest, with participants completing about half of the available online trainings and weekly behavior tracking opportunities. While this level of participation may be interpreted as modest, it is also comparable to a prior effective mobile health intervention with commercial truck drivers that was evaluated with a randomized controlled design.[33] To illustrate, in a six-month long body weight management intervention truck drivers completed about 9 out of 26 weekly tracking submissions on average (~35% of total possible logs).[33] In the current intervention, new bus operators completed an average of about 20 out of 40-41 of possible weekly tracking submissions. However, it is still a worthy effort for future research to experiment with factors that might increase intervention participation. These factors could include a simplified incentive structure, or more frequent (e.g., weekly) or larger incentives. Future extensions might also alter the behavioral design of challenges or technology to increase appeal or reduce effort to participate [50] (e.g., ease of website login, reducing number of clicks, increase quality of the user interface, enhanced gamification; reducing number of training topics in the first challenge). Qualitative interviews were explored to identify aspects of the intervention that participants enjoyed, as well as aspects that could be improved. Positive aspects of the intervention included making social connections and being provided feedback during health assessments. Aspects that could be improved in the future are implementing automatic reminders, increasing incentives for completing trainings, and adapting surveys to be more relevant and less repetitive.

The COVID-19 pandemic had dramatic impacts on the transit industry during the study period. To understand the particular context, we describe COVID-19 impacts that altered body weight measurements and intervention implementation. COVID-19 stay-at-home orders were put in place between Visits 2 and 3 for the controls and second intervention cohort, and between Visits 3 and 4 for the first intervention cohort (between 6 and 9 months tenure for both control and intervention participants). Additional limitations on study activities (e.g., in-person vs. virtual visits/training) were imposed by the University and employers. In response to these disruptions, we collected some weight measurements for intervention participants' during this time period via self-weighing with their personal scales, which had unknown reliability relative to our study scales. Control participants self-weighed using our provided scale. To obtain some level of verification of weight measures, we requested photographs of participants' self-weighing results for operators in both conditions. The self-weighing data points in our study should have limited impact on interpreting overall results, however, because for both intervention and control conditions, the 3- and 12-month body weight measurements were completed in-person with research staff. Intervention training and challenges were suspended for 3 months at the intervention site at the same time self-weighing was initiated. After that 3-month delay, the graduation session was completed online (video conference) with the first intervention cohort, and the final two training sessions and graduation session were moved online for the second intervention cohort. On one hand, it is impressive that a body weight management intervention appeared to work under such disruptive circumstances. On the other hand, the intervention was completed while disruptions reduced work hours for participants, with decreases of about 4 and 7 hours per week on average for control and intervention

participants, respectively. This may have created more opportunity for participants to self-manage health behaviors (e.g., intervention participants sleeping longer). In total, the uniqueness of the study time period highlights the need to replicate the intervention in the future under more “normal” conditions.

CONCLUSION

The present pilot study represents an important step forward in preventing obesity and its health effects among bus operators, while also supporting their early job success. Our preliminary findings suggest that weight gain among new bus operators may be prevented with an enhanced health and job success intervention that is integrated with standard onboarding processes. In addition, the intervention may positively impact operators’ socialization adjustment during their first year of employment, which may ultimately lead to greater job performance, satisfaction, and employee retention. While pilot study effect size estimates were very encouraging, future replications and our planned fully powered randomized controlled trial are needed to draw strong conclusions about intervention effectiveness.

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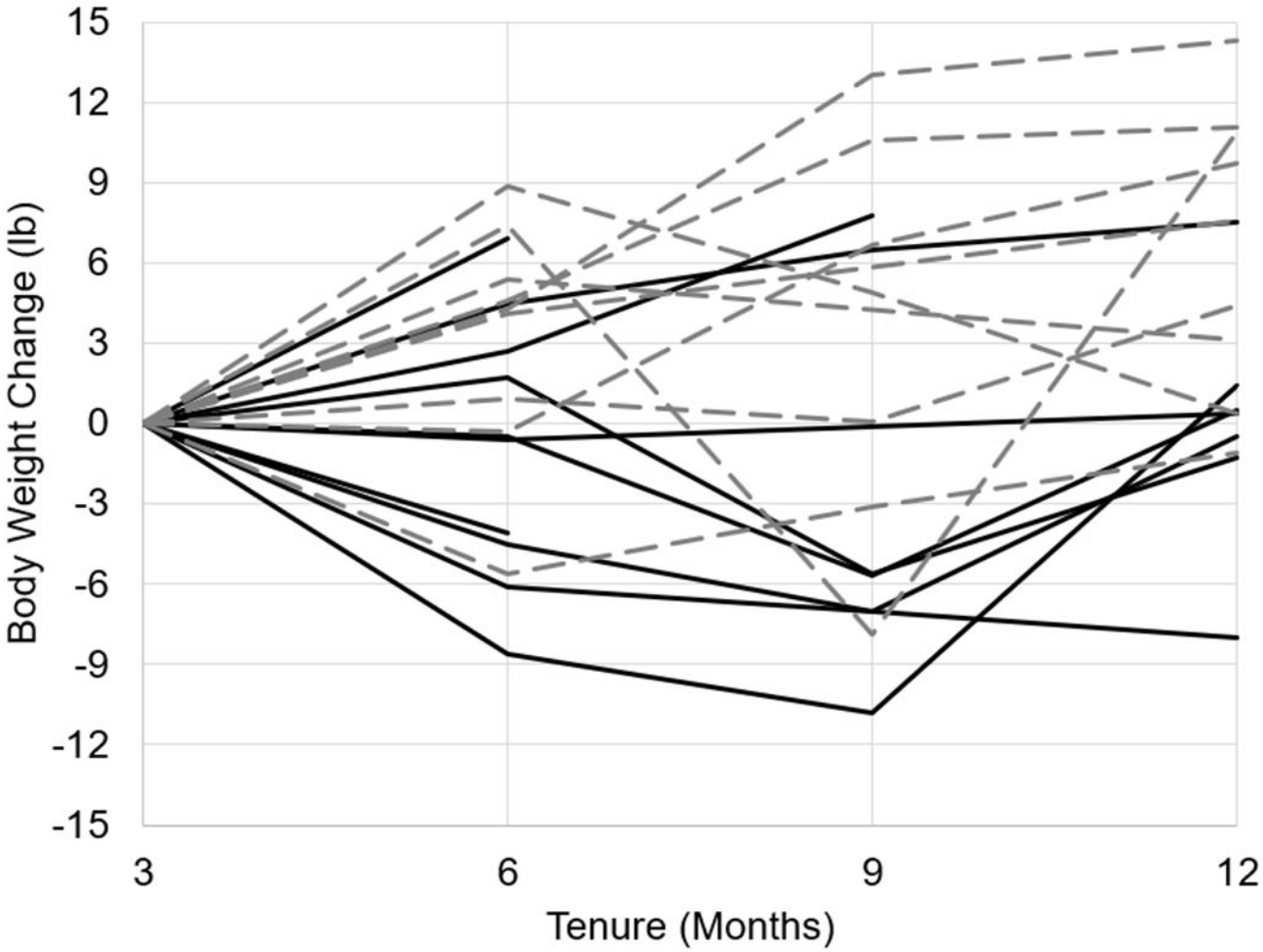

Figure 1. Body Weight Change across Tenure

Note. Each line represents a participant's weight centered on their tenure-aligned baseline weight (i.e., weight at 3-months post-hire). The dotted grey lines indicate control participants, and the solid black lines indicate intervention participants.

Table 1.

Driver Demographic and Work Characteristics at 3-Month Baseline

Variable	Intervention (*n*=14) Mean (*SD*) or *n* (%)	Control (*n*=9) Mean (*SD*) or *n* (%)	Total Sample (*n*=23) Mean (*SD*) or *n* (%)
Age (years)	49.57 (8.92)	44.44 (10.79)	47.56 (9.78)
Sex (% Female)	5 (35.71%)	5 (55.56%)	10 (43.48%)
Race			
American Indian/Alaskan Native	2 (14.29%)	0 (0%)	2 (8.70%)
Black/African American	2 (14.29%)	0 (0%)	2 (8.70%)
White	8 (57.14%)	7 (77.78%)	15 (65.22%)
Other or >1 race	2 (14.29%)	2 (22.22%)	4 (17.39%)
Household			
Married or Living with Partner	7 (50.00%)	6 (66.67%)	14 (60.87%)
Dependent Children ≥1	6 (42.86%)	4 (44.44%)	10 (43.48%)
Education			
High-school diploma or GED	2 (14.29%)	2 (22.22%)	4 (17.39%)
Some college, Technical school, or Bachelor's degree	12 (85.71%)	7 (77.78%)	19 (82.61%)
Work Hours per Week[a]	44.36 (5.99)	43.22 (3.23)	43.85 (4.86)
Work Hours Outside of 8am-5pm (%)[a]	50.55% (21.27)	55.78% (19.33)	52.90% (20.06)
Shift Type[a]			
Fixed Route	4 (36.36%)	6 (85.71%)	10 (55.56%)
Extra Board	8 (72.73%)	1 (14.29%)	9 (50.00%)
Paratransit	1 (9.09%)	0 (0%)	1 (5.56%)
Health Conditions			
High blood pressure	4 (28.57%)	3 (33.33%)	7 (30.43%)
High Blood Pressure Medication[b]	4 (100%)	2 (66.67%)	6 (85.71%)
Technology Experience			
Comfort using Computers (% Somewhat/Very Comfortable)	8 (57.14%)	6 (66.67%)	14 (60.87%)
Technology Owned			
Laptop	12 (85.71%)	6 (66.67%)	18 (78.26%)
Home Computer	4 (28.57%)	5 (55.56%)	9 (39.13%)
Tablet	7 (50.00%)	5 (55.56%)	12 (52.17%
Smartphone	11 (78.57%)	9 (100%)	20 (86.96%)
Accessing Internet via phone or computer weekly or more often	14 (100%)	9 (100%)	23 (100%)
Device most frequently used to access Internet			
Smartphone	12 (85.71%)	--	20 (86.96%)
Laptop or tablet	2 (14.29%)	--	3 (13.04%)

Note:

[a]Values computed at 3-months since hire (i.e., Visit 1 for Control condition and Visit 2 for Intervention condition).

[b]Percentages were calculated as the ratio of individuals currently taking medication to total number of participants that reported being diagnosed with the health conditions, respectively.

Table 2.

Pilot Protocol Description

Group Training - *Online Challenge Name*	**Online Challenge Description**
Orientation - *Website Warm Up* Goals and Activities: To introduce health and job success factors, the overall program, and start the website warm up challenge. During session operators logged into website on tablets, completed an online orientation to the website, and set goals for the website warm up challenge. Example Activity: My Vision for Success in my First Year (identifying desired outcomes in work, health, and life domains).	Duration and Theme: 2-4 week long practice using the website, and introduction to concepts of SHIFT Onboard. Weekly Logging of health and job success indicators (body weight, self-rated job performance) and behavioral goals associated with each. Online Training (3): • SHIFT Onboard Orientation (done in class) • Health Success • Job Success Incentives: • $5 per log • $10 per training
Challenge 1 - *Getting Started!* Goals and Activities: Website warm-up review, and those who achieved medals acknowledged. Self-management strategies shared and described, and activities to help operators select their goals and make action plans. Logging in to website on tablets to set goals for the challenge. Example Activities: Strengths Identification (reflecting on and selecting individual strengths from a list, and discussing with the group). At a separate "graduation" event hosted by the employer, each operator was given an insulated lunch bag with a printed copy of the Harvard Healthy Eating Plate inside.	Duration and Theme: 3-month long challenge as operators' begin service. Focused on body weight management and each operator's choice of job success factors. Weekly logging of health and job success indicators (body weight, self-rated job performance) and behavioral goals associated with each. Online Training (8): Health Success Topics • Eating • Exercise • Sleep • Stress Management Job Success Topics • Clarity • Compliance • Connection • Coping Incentives: • $5 per log • $10 per training • Bonuses for tracking streaks of 2-3 weeks ($5) or 4 weeks ($10) • Bonuses for earning challenge medals for completing roughly 30% (bronze=$25), 50% (silver=$50), and 75% (gold $100) of expected online activities
Challenge 2 - *Thrive While you Drive* Goals and Activities: Challenge 1 review, and acknowledge those who achieved medals. After 3 months in service, acknowledging the work honeymoon period vs. work realities, including stressors, challenges, and frustrations. Continued focus on health and job success factors to succeed, especially ways of healthfully coping with work realities. Example Activity: Practicing the three good things journaling exercise (three gratitudes) and discussing with the group.	Duration and Theme: 3-month long challenge focused on healthy coping strategies including practices from positive psychology and the science of happiness. Operators also get to choose a "team" to focus on a health success factor most important to them. Weekly Logging of health and job success indicators (body weight, self-rated job performance) and behavioral goals associated with each. Online Training Topics (3): • Challenge 2 Orientation (done in class) • Thrive While you Drive! • Selected health success factor topic (Eating, Exercise, Sleep, Stress Management) Incentives: • $5 per log • $10 per training • Bonuses for tracking streaks of 2-3 weeks ($5) or 4 weeks ($10) • Bonuses for earning challenge medals for completing roughly 30% (bronze=$25), 50% (silver=$50), and 75% (gold $100) of expected online activities
Challenge 3 - *Taking Stock and Taking Charge* Goals and Activities: Challenge 2 review, and acknowledge those who achieved medals. After 6 months in service, taking stock of where operators are really at compared to when they started with each health and job success factor (stayed the same, got worse, improved). Example Activities: Taking Stock (individual and group ratings of each success factor as staying the same, gotten worse, or gotten better); Confidence Scale (assessing confidence in achieving goals, and discussing to relate to strengths and build and support self-efficacy).	Duration and Theme: 3-month long challenge focused on making a realistic assessment of where people are relative to their original vision for success. Operators encouraged set goals and review training related to an area that had stayed the same or gotten worse in the taking stock activity. Weekly Logging of health and job success indicators (body weight, self-rated job performance) and behavioral goals associated with each. Online Training (1): • Taking Stock and Taking Charge! Incentives: • $5 per log • $10 per training • Bonuses for earning challenge medals for completing roughly 30%

Group Training - *Online Challenge Name*	Online Challenge Description
	(bronze=$25), 50% (silver=$50), and 75% (gold $100) of expected online activities
Graduation **Goals and Activities**: Challenge 3 review, and acknowledge those who achieved medals. Review of health and job success factors, and all accomplished through the program and each challenge. **Example Activity**: Advice for New Operators (now with your experience, and looking back, what advice would you give to new operators just getting started?).	Not applicable

Table 3.

Awards for Each Online Challenge

Challenge	Bronze Medals	Silver Medals	Gold Medals	Total Medals
Website Warmup	2	4	4	10
Challenge 1	5	3	2	10
Challenge 2 Total [a]	0	1	7	8
Eating	0	0	1	1
Exercise	0	0	3	3
Sleep	0	1	2	3
Stress Management	0	0	1	1
Challenge 3	2	2	5	9

[a]Challenge 2 totals are calculated by summing respective medals from “Eating,” “Exercise,” “Sleep,” and “Stress Management” values (i.e., the challenges that participants had the option to select during Challenge 2).

Table 4.

Absolute Intervention Effects

Outcome	Intervention Mean (SD)	Control Mean (SD)	Intervention Mean Difference from 3-Month[a]	Control Mean Difference from 3-Month[a]	Absolute Intervention Effect from 3-Month	Effect Size (d)
Primary Outcomes						
Body Weight (lbs)						
3-mo Baseline[b] (w/6 mo)	210.94 (35.07)	236.20 (57.67)				
3-mo Baseline[b] (w/9 mo)	225.03 (29.57)	239.19 (60.25)				
3-mo Baseline[b] (w/12 mo)	215.64 (40.61)	236.20 (57.67)				
6-Month	210.08 (35.38)	239.50 (58.59)	−0.86 (4.94)	3.30 (4.39)	−4.16	−0.89
9-Month	221.91 (33.46)	242.66 (61.33)	−3.11 (7.23)	3.47 (7.50)	−6.59	−0.89
12-Month	215.64 (42.47)	242.91 (58.93)	0.00 (4.56)	6.71 (5.28)	−6.71	−1.35
Fruit/Veg (servings)						
3-mo Baseline[b] (w/6 mo)	3.10 (1.77)	2.41 (1.78)				
3-mo Baseline[b] (w/9 mo)	2.71 (1.41)	2.41 (1.78)				
3-mo Baseline[b] (w/12 mo)	2.76 (1.65)	2.41 (1.78)				
6-Month	2.66 (1.29)	3.98 (3.64)	−0.44 (1.38)	1.57 (3.47)	−2.00	−0.78
9-Month	6.52 (7.96)	3.39 (3.14)	3.81 (7.90)	0.98 (1.58)	2.83	0.50
12-Month	2.26 (1.65)	2.39 (1.62)	−0.50 (0.69)	−0.02 (0.86)	−0.47	−0.61
Sugary Snacks (0-9)						
3-mo Baseline[b] (w/6 mo)	3.33 (1.80)	3.88 (1.55)				
3-mo Baseline[b] (w/9 mo)	3.00 (1.60)	3.88 (1.55)				
3-mo Baseline[b] (w/12 mo)	3.29 (1.50)	3.88 (1.55)				
6-Month	3.44 (1.33)	3.50 (1.85)	0.11 (1.36)	−0.38 (2.83)	0.49	0.23
9-Month	2.75 (1.39)	2.88 (2.17)	−0.25 (2.05)	−1.00 (3.12)	0.75	0.28
12-Month	3.00 (1.63)	2.75 (1.28)	−0.29 (0.95)	−1.13 (2.30)	0.84	0.46
Sugary Drinks (0-9)						
3-mo Baseline[b] (w/6 mo)	3.00 (2.06)	4.63 (1.92)				

Outcome	Intervention Mean (SD)	Control Mean (SD)	Intervention Mean Difference from 3-Month[a]	Control Mean Difference from 3-Month[a]	Absolute Intervention Effect from 3-Month	Effect Size (d)
3-mo Baseline[b] (w/9 mo)	3.00 (2.20)	4.63 (1.92)				
3-mo Baseline[b] (w/12 mo)	3.00 (2.38)	4.63 (1.92)				
6-Month	2.44 (2.01)	4.13 (1.96)	−0.56 (1.33)	−0.50 (2.51)	−0.06	−0.03
9-Month	2.63 (0.74)	3.00 (2.88)	−0.38 (2.26)	−1.63 (3.74)	1.25	0.40
12-Month	2.00 (1.73)	2.50 (1.85)	−1.00 (3.06)	−2.13 (2.59)	1.13	0.40
Fast Food (0-9)						
3-mo Baseline[b] (w/6 mo)	1.67 (0.87)	2.25 (1.39)				
3-mo Baseline[b] (w/9 mo)	1.63 (0.92)	2.25 (1.39)				
3-mo Baseline[b] (w/12 mo)	1.71 (0.95)	2.25 (1.39)				
6-Month	1.67 (1.32)	2.00 (1.31)	0.00 (1.50)	−0.25 (1.16)	0.25	0.19
9-Month	1.25 (1.04)	1.38 (1.60)	−0.38 (1.06)	−0.88 (1.81)	0.50	0.34
12-Month	1.29 (1.11)	1.25 (1.28)	−0.43 (1.13)	−1.00 (1.51)	0.57	0.42
Meals from Home (0-9)						
3-mo Baseline[b] (w/6 mo)	5.11 (1.27)	5.00 (1.31)				
3-mo Baseline[b] (w/9 mo)	4.88 (1.13)	5.00 (1.31)				
3-mo Baseline[b] (w/12 mo)	4.86 (1.22)	5.00 (1.31)				
6-Month	5.56 (1.33)	4.63 (2.67)	0.44 (1.67)	−0.38 (2.88)	0.82	0.35
9-Month	5.75 (2.97)	4.50 (2.33)	0.88 (3.04)	−0.50 (1.85)	1.38	0.55
12-Month	5.29 (1.60)	4.75 (2.32)	0.43 (2.07)	−0.25 (1.49)	0.68	0.38
Moderate Physical Activity (0-7)						
3-mo Baseline[b] (w/6 mo)	1.44 (1.01)	2.11 (2.15)				
3-mo Baseline[b] (w/9 mo)	1.50 (1.07)	2.25 (2.25)				
3-mo Baseline[b] (w/12 mo)	1.43 (1.13)	2.11 (2.15)				
6-Month	1.00 (1.32)	1.44 (1.42)	−0.44 (1.01)	−0.67 (2.12)	0.22	0.14
9-Month	2.63 (2.26)	1.88 (1.64)	1.13 (1.81)	−0.38 (1.41)	1.50	0.93
12-Month	1.57 (1.40)	2.00 (1.80)	0.14 (0.90)	−0.11 (1.27)	0.25	0.22
Vigorous Physical Activity (0-7)						

Outcome	Intervention Mean (SD)	Control Mean (SD)	Intervention Mean Difference from 3-Month[a]	Control Mean Difference from 3-Month[a]	Absolute Intervention Effect from 3-Month	Effect Size (d)
3-mo Baseline[b] (w/6 mo)	0.89 (1.17)	1.67 (2.18)				
3-mo Baseline[b] (w/9 mo)	1.00 (1.20)	1.75 (2.32)				
3-mo Baseline[b] (w/12 mo)	0.86 (1.22)	1.67 (2.18)				
6-Month	0.44 (0.53)	1.22 (1.39)	−0.44 (1.13)	−0.44 (1.13)	0.00	0.00
9-Month	0.75 (1.49)	2.00 (2.00)	−0.25 (0.89)	0.25 (1.28)	−0.50	−0.45
12-Month	1.29 (1.60)	1.33 (1.73)	0.43 (1.27)	−0.33 (1.50)	0.76	0.54
Sleep Duration Self-Report (hours)						
3-mo Baseline[b] (w/6 mo)	7.00 (1.35)	6.55 (1.08)				
3-mo Baseline[b] (w/9 mo)	7.00 (1.44)	6.35 (1.08)				
3-mo Baseline[b] (w/12 mo)	7.14 (1.49)	6.55 (1.16)				
6-Month	7.61 (1.17)	6.25 (0.75)	0.61 (1.27)	−0.30 (1.18)	0.91	0.74
9-Month	7.63 (2.07)	7.43 (0.79)	0.63 (1.83)	1.08 (1.15)	−0.46	−0.29
12-Month	8.00 (1.29)	6.81 (0.92)	0.86 (1.25)	0.26 (1.32)	0.60	0.47
Sleep Quality (0-3)[c]						
3-mo Baseline[b] (w/6 mo)	2.22 (0.67)	2.00 (0.50)				
3-mo Baseline[b] (w/9 mo)	2.25 (0.71)	2.00 (0.54)				
3-mo Baseline[b] (w/12 mo)	2.14 (0.69)	2.00 (0.50)				
6-Month	1.89 (0.78)	2.22 (0.44)	−0.33 (0.87)	0.22 (0.44)	−0.56	−0.80
9-Month	2.13 (0.99)	2.25 (0.89)	−0.13 (0.99)	0.25 (0.89)	−0.38	−0.40
12-Month	2.00 (0.58)	2.22 (0.67)	−0.14 (0.38)	0.22 (0.67)	−0.37	−0.64
10min Bouts per Week						
3-mo Baseline[b] (w/6 mo)	2.54 (2.09)	1.43 (3.07)				
3-mo Baseline[b] (w/9 mo)	2.73 (2.15)	1.60 (3.24)				
3-mo Baseline[b] (w/12 mo)	3.12 (2.00)	1.43 (3.07)				
6-Month	1.35 (1.58)	0.85 (1.22)	−1.19 (2.58)	−0.57 (3.00)	−0.62	−0.22
9-Month	1.72 (3.15)	3.50 (7.25)	−1.01 (2.42)	1.90 (4.31)	−2.91	−0.83

Outcome	Intervention Mean (SD)	Control Mean (SD)	Intervention Mean Difference from 3-Month[a]	Control Mean Difference from 3-Month[a]	Absolute Intervention Effect from 3-Month	Effect Size (d)
12-Month	3.24 (4.35)	1.00 (2.65)	0.12 (3.87)	−0.43 (0.64)	0.54	0.21
Time in 10min Bouts per Week (minutes)						
3-mo Baseline[b] (w/6 mo)	35.78 (36.20)	52.11 (135.49)				
3-mo Baseline[b] (w/9 mo)	38.88 (37.40)	58.63 (143.33)				
3-mo Baseline[b] (w/12 mo)	44.43 (36.66)	52.11 (135.49)				
6-Month	16.87 (19.95)	12.02 (16.20)	−18.91 (34.39)	−40.09 (130.94)	21.18	0.22
9-Month	34.94 (72.13)	70.40 (160.50)	−3.94 (47.05)	11.77 (24.69)	−15.71	−0.42
12-Month	44.45 (66.65)	37.44 (106.11)	0.02 (45.78)	−14.67 (30.99)	14.69	0.39
Sleep Duration Actigraphy (hours)						
3-mo Baseline[b] (w/6 mo)	6.49 (2.71)	6.83 (0.57)				
3-mo Baseline[b] (w/9 mo)	5.99 (3.02)	6.83 (0.57)				
3-mo Baseline[b] (w/12 mo)	5.99 (3.02)	6.91 (0.56)				
6-Month	7.24 (1.06)	6.70 (0.94)	0.75 (3.16)	−0.13 (0.76)	0.88	0.38
9-Month	7.66 (1.20)	7.61 (0.54)	1.67 (3.37)	0.78 (0.64)	0.89	0.40
12-Month	7.56 (0.91)	6.50 (0.86)	1.57 (2.71)	−0.41 (1.00)	1.99	1.00
Sleep Efficiency Actigraphy (%)						
3-mo Baseline[b] (w/6 mo)	79.82 (32.49)	87.63 (4.00)				
3-mo Baseline[b] (w/9 mo)	76.61 (37.69)	87.63 (4.00)				
3-mo Baseline[b] (w/12 mo)	76.61 (37.69)	87.27 (4.18)				
6-Month	90.68 (2.60)	87.38 (4.86)	10.86 (32.86)	−0.25 (2.30)	11.11	0.48
9-Month	88.45 (2.88)	88.75 (2.98)	11.84 (39.02)	1.12 (3.19)	10.73	0.42
12-Month	89.77 (3.72)	87.22 (2.86)	13.16 (37.73)	−0.05 (3.82)	13.22	0.52
Secondary Outcomes						
Role Clarity						
3-mo Baseline[b] (w/6 mo)	36.89 (6.01)	35.75 (7.15)				
3-mo Baseline[b] (w/9 mo)	36.25 (6.09)	35.75 (7.15)				

Outcome	Intervention Mean (SD)	Control Mean (SD)	Intervention Mean Difference from 3-Month[a]	Control Mean Difference from 3-Month[a]	Absolute Intervention Effect from 3-Month	Effect Size (d)
3-mo Baseline[b] (w/12 mo)	35.43 (6.08)	35.75 (7.15)				
6-Month	37.22 (3.90)	37.38 (4.10)	0.33 (4.87)	1.63 (5.97)	−1.29	−0.24
9-Month	37.75 (3.81)	35.75 (5.18)	1.50 (4.72)	0.00 (6.39)	1.50	0.27
12-Month	34.71 (5.38)	35.88 (4.36)	−0.71 (8.69)	0.13 (4.52)	−0.84	−0.12
Social Connection						
3-mo Baseline[b] (w/6 mo)	29.22 (6.00)	32.38 (2.83)				
3-mo Baseline[b] (w/9 mo)	28.50 (5.98)	32.38 (2.83)				
3-mo Baseline[b] (w/12 mo)	28.00 (6.27)	32.38 (2.83)				
6-Month	28.56 (5.53)	26.50 (9.02)	−0.67 (2.12)	−5.88 (10.12)	5.21	0.74
9-Month	29.00 (6.50)	27.00 (9.93)	0.50 (3.16)	−5.38 (10.31)	5.88	0.77
12-Month	28.43 (6.09)	27.25 (9.42)	0.43 (3.16)	−5.13 (10.23)	5.55	0.71
Self-Efficacy						
3-mo Baseline[b] (w/6 mo)	13.78 (1.30)	14.00 (1.77)				
3-mo Baseline[b] (w/9 mo)	13.63 (1.30)	14.00 (1.77)				
3-mo Baseline[b] (w/12 mo)	13.57 (1.40)	14.00 (1.77)				
6-Month	14.33 (1.00)	13.88 (1.36)	0.56 (1.88)	−0.13 (1.25)	0.68	0.43
9-Month	14.50 (0.76)	14.00 (1.31)	0.88 (1.46)	0.00 (0.93)	0.88	0.72
12-Month	14.71 (0.49)	13.88 (1.36)	1.14 (1.46)	−0.13 (2.03)	1.27	0.71
Job Satisfaction						
3-mo Baseline[b] (w/6 mo)	13.56 (1.74)	14.50 (1.07)				
3-mo Baseline[b] (w/9 mo)	13.38 (1.77)	14.50 (1.07)				
3-mo Baseline[b] (w/12 mo)	13.14 (1.77)	14.50 (1.07)				
6-Month	14.46 (1.01)	13.88 (1.89)	1.00 (1.58)	−0.63 (1.30)	1.63	1.12
9-Month	14.63 (1.06)	13.88 (1.55)	1.25 (1.75)	−0.63 (1.19)	1.88	1.26
12-Month	14.43 (1.13)	11.75 (4.23)	1.29 (1.70)	−2.75 (4.37)	4.04	1.19
Work Stress						
3-mo Baseline[b] (w/6 mo)	26.00 (9.75)	26.25 (5.50)				

Outcome	Intervention Mean (SD)	Control Mean (SD)	Intervention Mean Difference from 3-Month[a]	Control Mean Difference from 3-Month[a]	Absolute Intervention Effect from 3-Month	Effect Size (d)
3-mo Baseline[b] (w/9 mo)	28.13 (7.88)	26.25 (5.50)				
3-mo Baseline[b] (w/12 mo)	28.14 (8.51)	26.25 (5.50)				
6-Month	24.56 (10.90)	26.38 (9.23)	−1.44 (7.83)	0.13 (6.29)	−1.57	−0.22
9-Month	18.38 (7.39)	24.25 (9.13)	−9.75 (4.65)	−2.00 (5.10)	−7.75	−1.59
12-Month	20.00 (7.39)	23.25 (7.13)	−8.14 (4.81)	−3.00 (4.31)	−5.14	−1.13

Note. SD is standard deviation. Absolute intervention effects were computed by subtracting the Control differences from the Intervention differences across the listed time frames. Effect Size (d) is Cohen's d of the absolute intervention effect using the pooled standard deviation of the difference (EQ1). Fruit/Veg was computed as fruit and vegetable servings per day. Sugary snacks, sugary drinks, fast food, and meals from home were scored on a frequency scale from 0-"Never" to 9-"5 or more times per day" in the past month. Sleep duration was computed as hours per night.

[a]Difference scores were computed using pairwise deletion (i.e., using valid cases for the two time points in each respective difference test: 6-Month, 9-Month, and 12-Month) in order to maximize data for each test.

[b]3 Month values represent the means and standard deviations used for each pairwise comparison, respectively (i.e., the first is used for the 3-to-6 month comparison, the second for the 3-to-9 month, and the last for 3-to-12 month).

[c]Higher scores indicate worse sleep quality.