Adherence to and Efficacy of a Connected, Home-Based Digital Resistance Training Platform Incorporating Virtual Workouts (Tonal®) on Physical Performance, Indices of Cardiometabolic Health, Feasibility, and System Usability: An Exploratory Study

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Abstract

Objective: The goal of this study is exploring the equal or even greater benefits on health that a connected home-based digital resistance training platform offers when compared to alternate commercial-based workouts. This study will build on previous work that has validated the efficacy of exercise training programs in the commercial health club setting and explore a newer paradigm of tech-enabled, home-based digital exercise training.

Methods: This research will be a 12-week, prospective, single-blind study using a convenience sample of participants who will be randomized into one of two treatment groups, the intervention Tonal digital exercise training (TONAL) or the control Self-directed training (SELF). The participants will work out 3-4 weekly for ~1 hour with the primary objective of increasing muscle strength and lean body mass with concomitant decrease in fat mass. Both groups will train at personal discretion, choosing workouts in the absence of direct coaching while stipulating to the guidelines aforementioned.

Introduction

Spurred on by the COVID-19 pandemic and stay-at-home orders mandating the nationwide closure of most public and private gyms, Americans began to prioritize at-home workouts as a means of maintaining their health and fitness. While social distancing and limiting exposure in public spaces were necessary strategies to slow the coronavirus spread, these have also led to greater inactivity amongst the general population. This increase in inactivity poses widespread health consequences with many bodies of research supporting the link between physical inactivity and chronic disease progression. Thus, the demand for an effective at-home exercise alternative is at an all-time high. Nascent technological advances have emerged in the home-based fitness landscape with new products and applications incorporating virtual training via connected fitness equipment. Such systems have become known as 'smart/AI home gyms' and they seek to improve the user's fitness and cardiometabolic health from the comfort of their own home. Studies have found that home-based exercise training interventions utilizing remote, 'virtual trainers' are just as efficacious and economically viable compared to face-to-face training. The relative convenience and constant access to virtually guided workouts have also resulted in increased adherence in a myriad of these exercise regimens. For this reason, more diligent research is required to validate the benefits of home-based digital exercise training in respect to consumer health and fitness.

Workout adherence serves as the predominant limiting factor in health and fitness outcomes. Many studies examine the effects of exercise programs, noting a high proportion of participants failing to follow the program and dropping out after an extended period. Tonal's multimodal platform, as a home-based alternative to traditional training at commercial fitness clubs, has potential to produce a different result. Tonal's combination of proprietary digital weight, artificial intelligence, and expert-led coaching provides hundreds of virtual training workouts that are physically demanding, emotionally appealing, and socially engaging. The equipment's accessibility offers individuals the convenience to select the duration of their workouts. Such flexibility of choice has been shown to increase the frequency of workouts performed in the long term. The virtual coaching, self-monitoring, and goal setting integrated into the Tonal platform may also contribute to adherence. Virtual coaches play a vital role in regular supervision, positive reinforcement, and workout accountability which are all essential for adherence. Moreover, the Tonal platform enables users to monitor their form and exertion in real time, offering insight into their pace, positioning, and range of motion. Its AI technology allows for maximum exertion at all points due to mid-workout machine response based on user muscle fatigue. Finally, the Tonal platform allows users to track their progress and encourages reasonable goal-setting, promoting task appreciation which also contributes to greater motivation and adherence.

Purpose

Aim 1: To assess physical performance measures following a 3-month workout intervention that utilizes Tonal. Metrics of interest will be taken at baseline and post intervention for comparison.

- **Hypothesis:** There will be significant improvements in fat-free mass body composition and fitness parameters in the TONAL group over the control group.

Aim 2: To measure cardiometabolic health indices including fat mass/bodyfat% composition and circumferences, resting heart rate, heart rate variability, and blood pressure after 3 months of a workout intervention that uses Tonal.

- **Hypothesis:** There will be significant improvements in all cardiometabolic health measures in the TONAL group over the control group.

Aim 3: To measure subject adherence and retention, physical activity enjoyment, and system usability scales during a 3-month workout intervention that incorporates Tonal.

- **Hypothesis:** Subjects will demonstrate significant adherence and retention coupled with favorable physical activity enjoyment in the TONAL group over the control. The system usability scores will also be positive during the training.

Aim 4: To measure sleep metrics and biochemical profiling (i.e., blood biomarkers of performance progression/digression) during a 3-month workout intervention that uses Tonal.

- **Hypothesis:** There will be significant improvements in sleep metrics and favorable changes in biochemical blood markers in the TONAL group over the control.

Figure 1. Tonal home gym equipment set up configurations.

Methods

Study Design

Participants will be randomized into one of two treatment groups:

- TONAL: Participants will be instructed on all aspects of the training platform. Thereafter, they will have free-will in choosing and completing workouts for the study. The selection of thrice weekly, 1-month programs already developed by Tonal that adhere to the primary objective of the study is encouraged. In addition, an ad hoc 1x/week workout that deviates away from the primary objective to more recovery and/or non-resistance exercises is also encouraged.

- SELF: Participants will be permitted to train using methods of their choosing (*i.e.*, self-directed) but with the understanding that increasing muscle strength and lean body mass while concomitantly decreasing fat mass is the primary objective. A UC Fit-derived exercise log app of each session that includes resistance exercise type, frequency, along with training duration will be collected for the training's entirety.

Screening Measures

Questionnaires: The participants will complete a pre-participation medical questionnaire (PAR-Q) and an exercise history questionnaire.

Electrocardiogram: All participants will undergo a recently validated screening electrocardiogram to ensure that it is within normal limits for participation in the study. ECG will be reviewed by one of the Principal Investigators before the participant is randomized.

Cardiometabolic Measures

Anthropometry: Body mass and height will be determined and used to calculate body mass index. Digital anthropometry will be used to measure body circumferences at eight anatomical sites.

Body Composition: Body fat%, fat mass, and lean body mass will be assessed.

Blood Pressure and Resting Heart Rate: Seated blood pressure and resting heart rate will be measured after participants have rested quietly for a minimum of 10 minutes.

Heart Rate Variability: The participants will be fitted with a wrist-worn device and associated smartphone to capture their vagally-mediated HRV response.

Performance Measures

Muscle Strength and Endurance: Muscle strength will be assessed by the 1-repetition maximum (1-RM) method for the seated leg and seated chest press exercises.

Lower Body Power: Leg power will be estimated using a previously validated electronic jump mat.

Aerobic Performance: Aerobic capacity, VO_2max, and the lactate (metabolic) threshold will be determined by gas exchange, $VO_2$0.

Energy Expenditure: A portable metabolic analysis machine will be used to determine EE during a signature workout session.

Modified Sit-in-Reach Test: The sit-and-reach test will be used as a standard measurement tool for evaluating hamstring and lower back flexibility.

Blood Biomarker/Biochemical Profiling

Glucose Metabolism: Fasting insulin, fasting glucose and glycosylated Hemoglobin HbA1c will be assessed.

Lipid Profile: Total cholesterol, LDL, HDL, CHOL:HDL ratio and triglycerides will be assessed.

Systemic Inflammation: CRP (C-reactive protein) will be assessed.

Thyroid Function: Total T3 and TSH (Thyroid Stimulating Hormone) will be assessed.

Anabolic Hormones: IGF-1 levels will be assessed.

Adrenal stress hormones: Random cortisol and DHEA-s will be taken and compared.

Statistical Analysis

Baseline and post-assessment data will be expressed with descriptive statistics. Dependent t-tests will assess changes in the primary and secondary outcome variables. Between groups (TONAL vs SELF) comparisons for differences in the outcome variables' changes will be determined with independent t-tests. Statistical significance will be identified at $P<0.05$. We will screen the data for outliers and violations of model assumptions and to assess the need for transformations or non-parametric methods. Post hoc pair-wise contrasts will test changes from baseline measures. The co-primary outcome measures for this study relate to fat-free mass and muscular strength. A statistical power calculation reveals that we would need 12 participants in each of the two groups (with ~2.5 kg fat-free mass change) to demonstrate a difference with $\alpha=0.05$ and $\beta=0.80$.

Timeline

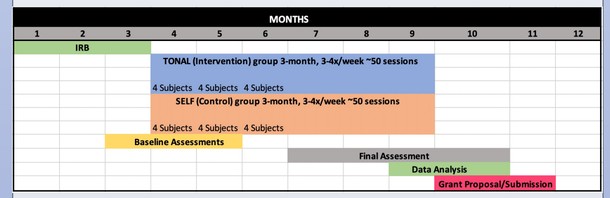

Table 1. Expected timeline for completion of study.

Significance

Advances in modern medicine have led to many pharmacological agents that control and treat non-communicable and lifestyle-induced diseases such as hypertension, dyslipidemia, obesity, and Type II Diabetes Mellitus. As a result, prescription medications often overtake lifestyle changes as the first line of treatment for these conditions. However, amidst what epidemiologists have identified as an "inactivity epidemic," the importance of widespread lifestyle alteration is becoming increasingly apparent. Moreover, improving physical activity may also offer a potential long-term solution to many health problems, thereby reducing the growing financial burden of healthcare which has been forecasted to equate to almost 2 trillion dollars annually in cardiovascular, diabetes, and obesity-related hypokinetic diseases.

The results of this study will serve as growing evidence to the literature on at-home fitness alternatives for the improvement of physical activity. Tonal provides solutions to certain barriers that traditional public and private gyms pose such as commute, space, and timing limitations. Its accessibility and adaptability to consumers' lives and schedules makes it a novel way to address said "inactivity epidemic." Further, its unique software may increase user adherence to workout regimens, thereby increasing increasing physical activity across and within individuals.

With mounting research showing the need for physical activity in order to achieve good health(1), manage chronic conditions, and prevent disease, studies like this can be sourced to inform future studies that delve into the clinical space. Using devices like Tonal in clinical research could provide patients with more accessible means to make lifestyle changes in order to improve their conditions and quality of life.

References

References are available upon request.

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