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Original Research

Comparing In-Person to Tele-Exercise High-Intensity Interval Training in Adults With Class II/III Obesity

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ABSTRACT

Objective: The COVID-19 pandemic accelerated the use of tele-exercise. Providers must now determine the most suitable modality of supervised exercise training for patients. This study compared exercise attendance and intensity during supervised high-intensity interval training (HIIT) between in-person and tele-exercise sessions among adults with class II/III obesity.
Methods: We conducted a secondary analysis of a randomized controlled trial of 62 participants examining exercise and surgical weight loss effects on neuropathy. Participants underwent 2 in-person supervised and 1 unsupervised HIIT sessions weekly for 2 years. After the pandemic onset, sessions shifted to tele-exercise. We evaluated associations between session attendance and intensity with pre- versus post-lockdown timing.
Results: Supervised session attendance increased after switching from in-person to tele-exercise sessions (incident rate ratio [IRR]: 1.50, 95% CI: [1.27, 1.79]). Pre-pandemic follow-up time was associated with decreased attendance (IRR: 0.95, 95% CI: [0.94, 0.97]), but supervised session attendance increased after the COVID-19 shutdown (IRR: 1.05, 95% CI: [1.03, 1.07]). Participants with prediabetes or diabetes showed reduced attendance, whereas those undergoing bariatric surgery had increased attendance. No change was seen in exercise intensity after switching from in-person to tele-exercise sessions (point estimate: −0.01, 95% CI: [−0.02, −0.01]), but small effects of follow-up time on exercise intensity were seen with increases over time before the pandemic and decreases after the lockdown.
Conclusion: Tele-exercise resulted in improved attendance for HIIT training among adults with class II/III obesity without meaningful differences in exercise intensity, supporting its use for this population.

Introduction

The COVID-19 pandemic disrupted traditional face-to-face health services, leading providers to explore alternative remote modes of delivery. As fitness and rehabilitation centers temporarily closed their doors throughout much of the nation, the pandemic accelerated the adoption of remote supervised exercise

Abbreviations: BMI, body mass index; HIIT, high-intensity interval training; HR, heart rate; HRmax, maximum heart rate; IRR, incident rate ratio; PE, point estimate.

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delivery ("tele-exercise") in health care.[1] Early studies evaluating the feasibility and effectiveness of tele-exercise have shown promising results across various patient populations.[2-4] However, the extent to which tele-exercise compares with traditional in-person exercise training in terms of long-term adherence to an exercise intervention (ie, exercise session attendance and intensity) remains largely unknown. As in-person exercise training has become possible again, health care providers must now consider which modality of supervised exercise to offer patients. Tele-exercise has potential to provide meaningful adjunctive care to traditional facility-based exercise training, with lower costs, improved continuity, and convenience.

Obesity is a significant modifiable risk factor for complications associated with COVID-19 infection.[5-7] Exercise is essential, not only as a strategy to better manage obesity but also for the pleiotropic health benefits that can reduce the risk of many disease complications, including COVID-19.[8] This further emphasizes the need to evaluate and implement exercise interventions in the population of individuals with obesity during the pandemic and beyond. Tele-exercise offers potential advantages such as cost savings for patients and health care systems, decreased travel time, and increased accessibility. However, there is a possibility of reduced exercise fidelity, which has not been explored in patients with class II/III obesity.

Our group conducted a randomized controlled trial to evaluate the impact of exercise and/or surgical weight loss on neuropathy in patients with class II/III obesity. We employed high-intensity interval training (HIIT) for its robust metabolic benefits and the potential for higher attendance among individuals with obesity compared with continuous, moderate-intensity exercise modalities, due in part to the reduced time commitment.[9-14] Participants completed 2 supervised and 1 unsupervised HIIT sessions per week for a period of 2 years following randomization. Due to the sudden onset of the COVID-19 pandemic in March 2020, the supervised in-person HIIT component of the trial transitioned abruptly to a tele-exercise model. As such, we performed a retrospective, secondary analysis aiming to compare patient exercise attendance and intensity between supervised in-person HIIT and tele-exercise HIIT sessions among patients with obesity.

Highlights

- Tele-exercise interventions have shown favorable attendance rates across various clinical populations, but there are few studies that compare them to in-person exercise interventions
- Transitioning to tele-exercise from in-person high-intensity interval training sessions reversed the decreasing trend in exercise attendance, implying that tele-exercise may enhance engagement and participation, especially among individuals with obesity
- While there was a small negative effect on exercise intensity with tele-exercise compared with in-person training, the difference was not clinically significant, suggesting tele-exercise can achieve similar exercise intensity as traditional methods

Clinical Relevance

As telehealth continues to be a post-COVID-19 reality, the demonstrated success of tele-exercise, especially in improving adherence, underlines the importance of continued research in this direction, potentially reshaping the future of health care delivery in exercise and rehabilitation.

Methods

Study Population and Study Design

The present study is a secondary analysis of data from an ongoing clinical trial where participants who were randomized to receive HIIT or routine exercise counseling. From October 2018 to July 2022, participants were enrolled into a clinical trial examining the effect of exercise and surgical weight loss on polyneuropathy. Patients were recruited from 3 centers on a rolling basis and followed for 2 years from their respective start date. Inclusion criteria were attending a bariatric surgery clinic, ≥40 years of age, and a body mass index (BMI) >35 kg/m^2 with at least one comorbid condition present or BMI >40 kg/m^2 with or without comorbid conditions present. Exclusion criteria included the use of anticoagulants, failed exercise stress test, use of a walking assist device, current smoking, weight >450 lbs (approximately 200 kg), and other factors that have been described previously.[15] Study participants were randomized 1:1 to receive supervised exercise training with a personal trainer versus standard of care exercise counseling. Randomization was stratified based on whether participants had undergone bariatric surgery (yes or no) and their baseline diabetes status (no diabetes, prediabetes, or diabetes). Participants' baseline maximum heart rate (HRmax) and peak VO_2 were measured by an exercise stress test as part of their screening visit. Peak VO_2 was defined as the largest amount of oxygen consumed during exercise testing. The present observational study includes retrospective data from clinical trial participants who were randomized to the HIIT arm and includes data collected from November 26, 2018 to October 30, 2022.

Intervention

Exercise training consisted of 2 supervised and 1 unsupervised HIIT session per week for the duration of the study. Prior to the pandemic, supervised in-person sessions were conducted at an exercise facility one-on-one with a Basic Life Support certified exercise trainer. Two sites were used for in-person training sessions. There were multiple trained study personnel who offered exercise training, and each participant was assigned to a single trainer throughout the study. Data were collected at each respective site from which the participant was recruited and submitted to study oversight for ongoing analysis. For both supervised and unsupervised sessions, participants performed self-selected exercise (eg, walk/run [outdoors or treadmill], elliptical machine, stair climbing, or cycling) for 10 intervals with the goal of 1-minute activity at 90% of baseline HRmax with 1-minute recovery periods at 50% baseline HRmax between each interval. During each session, heart rate (HR) was collected using a Polar (Kempele, Finland) device, which stored and transmitted data to the investigators, and peak HR was recorded for each interval. The 10 total peak HR values were averaged to produce a single average session peak HR. The session peak HR was compared with baseline HRmax to calculate the percentage of baseline HRmax exerted during training. Due to the COVID-19 pandemic, the study was temporarily paused on March 13, 2020, and resumed on April 3, 2020. Following the study's resumption, supervised tele-exercise sessions were conducted one on one with an exercise trainer over video conference (tele-exercise) in-home or in any setting of the participant's choosing. HR data from tele-exercise sessions were collected using the same methods as in-person sessions. Similar to unsupervised sessions prior to the pandemic, if participants lacked access to exercise equipment for supervised tele-exercise sessions, they were encouraged to perform interval training through alternative means such as walking outdoors, performing indoor stair exercises, or utilizing online or home exercise videos to perform stationary walking. In such cases, participants set up their device such that their physical activity could be viewed by the trainer via video conference. If they were exercising outdoors, the trainer would supervise the session via audio but no video communication. For both in-person and tele-exercise sessions, trainers scheduled visits based on the participants' availability, and participants completed their one weekly unsupervised session on their own time.

Medical Comorbidities

Neuropathy was defined using the Toronto consensus definition of probable neuropathy.[16] Waist circumference was assessed by averaging 2 repeated measurements without compressing the subcutaneous adipose tissue at the top of the iliac crest, as defined by the National Cholesterol Education Program.[17] Diabetes status was determined using A1C and glucose tolerance testing measurements, according to the 2025 American Diabetes Association Standards of Care definition.[18]

Outcomes

The primary outcome was supervised exercise attendance as defined by the number of supervised sessions completed. The secondary outcome was supervised exercise intensity as defined by the mean peak HR across the 10 HIIT intervals as a percentage of the baseline HRmax obtained during the exercise stress test. We also evaluated exercise attendance and intensity during unsupervised sessions, as this regimen remained unchanged prior to and after the COVID-19 pandemic.

We evaluated longitudinal exercise attendance and intensity using sequential 4-week follow-up intervals for each participant to account for some patients completing certain sessions earlier or later than scheduled based on participant convenience. This enabled us to capture a consistent window of exercise session attendance. For each 4-week interval, we totaled the number of sessions and calculated the mean peak HR percent of HRmax for each participant. The 4-week follow-up intervals were centered on the date of the COVID-19 shutdown, March 13, 2020. The first 4-week interval following the shutdown was composed of data collected directly after the study reopened on April 3, 2020.

Statistical Methods

Descriptive statistics were used to summarize participant demographic information and presence of relevant baseline comorbidities. To evaluate the effect of the transition to virtual supervised training sessions on the number of sessions participants completed during 4-week follow-up periods, we fit zero-inflated negative binomial mixed-effects regression models with random participant-specific intercepts. Specifically, we fit the number of supervised sessions per 4-week block, as a function of whether the 4-week block took place before or after the COVID-19 study shutdown, follow-up time in the study, and an interaction between the 2, with a random participant-specific intercept, after adjusting for participant age, sex, employment status, bariatric surgery status, neuropathy status at baseline, relative peak VO_2, diabetes/prediabetes status, and waist circumference. Follow-up time was defined as study follow-up relative to the COVID-19 pandemic start date. To aid in model convergence, age, waist circumference, and relative peak VO_2 were scaled by their respective SDs. We also fit the same model for unsupervised session attendance during the study.

To determine the effects of transitioning to tele-exercise supervised training on the intensity of exercise sessions, we fit a linear mixed-effects regression model with a random participant-specific intercept for the mean percent of maximum HR per 4-week block (for supervised and unsupervised sessions separately) including the same covariates as the zero-inflated negative binomial mixed-effects regression models. For each model, we performed sensitivity analyses using BMI or weight as replacements for waist circumference. Available case analysis was used to manage missing values. All hypothesis testing was evaluated at a $P < .05$ significance level. All analyses were performed using R 4.2.1 (R Core Team 2022).

Results

Study Recruitment and Retention

A total of 178 participants consented to participate in this study, 38 (21.3%) of which withdrew prior to randomization and 140 (78.7%) of which completed baseline assessments. Reasons for withdrawal prior to randomization included lost to follow-up (n = 12), other health issues (n = 5), other surgeries (n = 4), abnormal stress test (n = 3), time conflicts (n = 3), repeated cancellations (n = 3), no longer wished to participate in testing (n = 2), moved out of state (n = 2), vitamin B12 deficiency (n = 1), enrollment complete before able to complete baseline sessions (n = 1), A1C >12 % (n = 1), and inability to tolerate nerve conduction studies (n = 1). The 140 remaining individuals were subsequently randomized to HIIT or routine exercise counseling. For this study, the HIIT arm was composed of 62 participants following exclusion of 8 participants who either withdrew or who had follow-up session dates outside of the observational study period. Study recruitment, randomization, and retention patterns are further illustrated in Figure 1.

Baseline Characteristics of Study Participants

Table 1 presents the demographic information of study participants. A total of 62 (47.7%) participants were randomized to the HIIT exercise protocol, with a mean age of 50.5 ± 6.9 years. Most participants (82.3%) were female, White (74.2%), and non-Hispanic (98.4%). In terms of comorbidities, 25.8% of participants had diabetes, 24.2% had neuropathy, and 54.8% had undergone bariatric surgery at baseline. Of the 26 participants who began the study prior to the COVID-19 pandemic, no participants completed the study before the shutdown date.

Supervised Session Attendance

Study follow-up time prior to the COVID-19 pandemic was associated with a decrease in supervised exercise session attendance (incident rate ratio [IRR]: 0.95, 95% CI: [0.94, 0.97]). However, there was a significant increase in supervised exercise session attendance after the COVID-19 shutdown, when supervised sessions moved from in-person to tele-exercise sessions (IRR: 1.54, 95% CI: [1.30, 1.82]). Additionally, there was a significant interaction between study follow-up and whether sessions occurred before or after the COVID-19 shutdown, with increasing supervised session attendance over time after the COVID-19 shutdown (IRR: 1.05, 95% CI: [1.03, 1.07]). Individuals with prediabetes (IRR: 0.81, 95% CI: [0.74, 0.89]) and diabetes (IRR: 0.82, 95% CI: [0.74, 0.92]) had lower supervised session attendance compared with

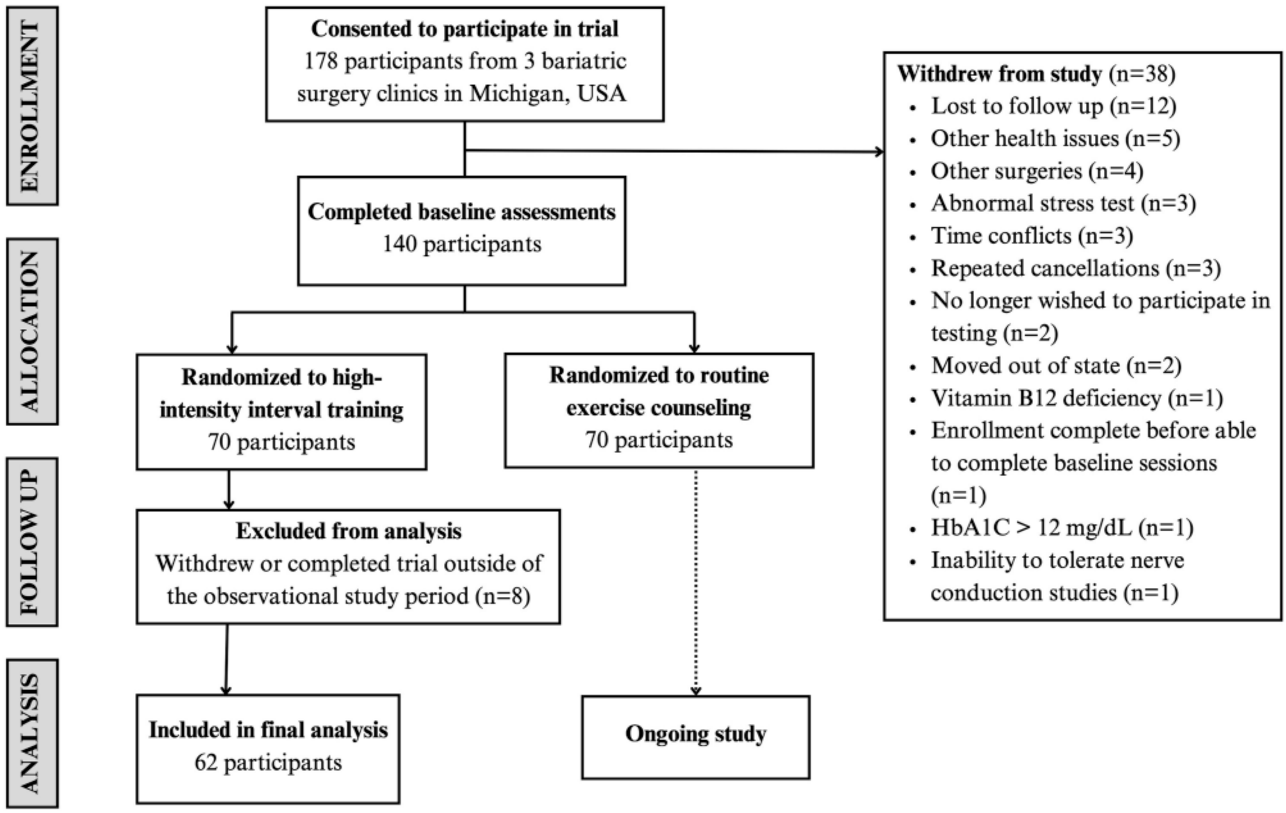

Fig. 1. Participant recruitment and retention.

Table 1
Demographic Information and Presence of Medical Comorbidities at Baseline

Variable	$N = 62$
Age, mean (SD)	50.5 (6.9)
Sex, *N* (%) Female	51 (82.3%)
Race, *N* (%)	
White	46 (74.2%)
Black/African American	13 (21.0%)
Bi/multiracial	3 (4.8%)
Ethnicity, *N* (%)	
Hispanic/Latino	1 (1.6%)
Employed, *N* (%)	
Yes	51 (82.3%)
Diabetes status	
Normoglycemic, *N* (%)	15 (24.2%)
Prediabetes, *N* (%)	31 (50.0%)
Diabetes, *N* (%)	16 (25.8%)
Bariatric surgery, *N* (%)	
Yes	34 (54.8%)
Neuropathy, *N* (%)	
Yes	15 (24.2%)
Waist circumference (cm), mean (SD)	132.4 (13.9)
Relative peak VO_2 (mL/kg/min), mean (SD)	22.6 (30.1)

patients with normoglycemia. Individuals who completed bariatric surgery had higher supervised session attendance compared with those who did not (IRR: 1.11, 95% CI: [1.03, 1.20]). Age (IRR: 1.05, 95% CI: [1.00, 1.09]) and relative peak VO_2 (IRR: 1.06, 95% CI: [1.03, 1.09]) were associated with increased supervised exercise session attendance. Finally, female patients had decreased exercise attendance compared with male patients (IRR: 0.86, 95% CI: [0.78, 0.96]).

Unsupervised Session Attendance

Study follow-up time was associated with an increased rate of unsupervised session attendance (IRR: 1.03, 95% CI: [1.01, 1.06]), prior to the COVID-19 shutdown. However, we found no significant difference in the rate of unsupervised session attendance before versus after the COVID-19 shutdown (IRR: 1.20, 95% CI: [0.96, 1.50]). There was a significant interaction effect between study follow-up time and whether sessions occurred before or after the COVID-19 shutdown, indicating unsupervised session attendance declined during study follow-up after the COVID-19 shutdown (IRR: 0.94, 95% CI: [0.92, 0.97]). Older age was associated with increased unsupervised session attendance (IRR: 1.10, 95% CI: [1.03, 1.16]). Similar to supervised sessions, individuals with prediabetes (IRR: 0.68, 95% CI [0.59, 0.79]) and diabetes (IRR: 0.59, 95% CI: [0.50, 0.70]) had lower rates of unsupervised session attendance compared with those with normoglycemia, whereas individuals who completed surgery had higher rates of unsupervised session attendance (IRR: 1.32, 95% CI: [1.18, 1.47]). Individuals who were employed had decreased rates of unsupervised session attendance (IRR: 0.58, 95% CI [0.51, 0.66]) compared with those who were not employed.

Intensity of Supervised and Unsupervised Sessions

Linear mixed-effects regression models revealed small significant increases in exercise intensity during study follow-up (prior to the COVID-19 shutdown) (supervised: point estimate (PE): 0.002, 95% CI: [0.001, 0.003], unsupervised: PE: 0.002, 95% CI: [0.0001, 0.003])). There were no significant effects of study follow-up before and after the COVID-19 shutdown (at baseline) (supervised: PE: −0.01, 95% CI: [−0.02, 0.01], unsupervised: PE: −0.01,

Table 2
Attendance (Number of Sessions) and Intensity (% Maximum Heart Rate) of Supervised and Unsupervised HIIT Sessions

Model Fixed effects estimates	No. of sessions (supervised) IRR (95% CI)	No. of sessions (unsupervised) IRR (95% CI)	% Max. HR (supervised) Est (95% CI)	% Max. HR (unsupervised) Est (95% CI)
Age (scaled)	1.05 (1.00, 1.09)[a]	1.10 (1.03, 1.16)[a]	0.002 (−0.01, 0.02)	−0.001 (−0.02, 0.02)
Sex (female)	0.86 (0.78, 0.96)[a]	0.82 (0.68, 0.99)[a]	−0.01 (−0.04, 0.03)	−0.02 (−0.02, 0.06)
Surgery (yes)	1.11 (1.03, 1.20)[a]	1.32 (1.18, 1.47)[a]	−0.01 (−0.03, 0.02)	−0.01 (−0.04, 0.02)
Employed (yes)	0.93 (0.84, 1.07)	0.58 (0.51, 0.66)[a]	−0.002 (0.03, 0.03)	0.001 (−0.04, 0.04)
Waist circumference (scaled)	1.02 (0.98, 1.07)	0.83 (0.78, 0.89)[a]	0.01 (−0.01, 0.02)	0.01 (−0.01, 0.02)
Diabetes	0.82 (0.74, 0.92)[a]	0.59 (0.50, 0.70)[a]	−0.01 (−0.05, 0.02)	−0.02 (−0.06, 0.03)
Prediabetes	0.81 (0.74, 0.89)[a]	0.68 (0.59, 0.79)[a]	0.003 (−0.03, 0.04)	0.01 (−0.03, 0.05)
Neuropathy (yes)	1.02 (0.92, 1.12)	1.04 (0.90, 1.20)	−0.004 (−0.03, 0.02)	0.02 (−0.01, 0.06)
Relative peak VO_2 (scaled)	1.06 (1.03, 1.09)[a]	1.02 (0.98, 1.06)	−0.01 (−0.006, −0.02)	−0.01 (−0.004, 0.03)
Follow-up	0.95 (0.94, 0.97)[a]	1.03 (1.01, 1.06)[a]	0.002 (0.001, 0.003)[a]	0.002 (0.0001, 0.003)[a]
After COVID shutdown (y/*n*)	1.54 (1.30, 1.82)[a]	1.20 (0.96, 1.50)	−0.01 (−0.02, 0.01)	−0.01 (−0.03, 0.002)
Follow-up[a] after COVID shutdown	1.05 (1.03, 1.07)[a]	0.94 (0.92, 0.97)[a]	−0.003 (−0.005, −0.002)[a]	−0.003 (−0.005, −0.002)[a]

Abbreviations: Est = parameter estimate; HIIT = high-intensity interval training; HR = heart rate; IRR = incident rate ratio.
[a] Indicates *P* value <.05.

95% CI: [−0.03, 0.002])) on the percent of HRmax during supervised or unsupervised sessions. However, we found significant interactions between study follow-up and whether sessions occurred before or after the COVID-19 shutdown (supervised: PE: −0.003, 95% CI: [−0.005, −0.002], unsupervised: PE: −0.003, 95% CI: [−0.005, −0.002]), indicating small decreases in exercise intensity during follow-up following the COVID-19 shutdown. No patient factors were associated with the percent of HRmax during supervised or unsupervised sessions (All $P > .05$; Table 2).

Sensitivity Analyses

Our sensitivity analyses, including BMI or weight instead of waist circumference, revealed subtle differences in effect sizes; however, changes were small and did not influence the overall interpretation of results.

Safety

There were 2 adverse events. One participant experienced mild chest pain during a workout and another participant fell off the treadmill.

Discussion

Summary of Findings

In this study, we investigated differences in exercise attendance and intensity based on participation in supervised in-person HIIT training versus supervised tele-exercise HIIT training for individuals with a BMI >35 kg/m^2 at baseline. To our knowledge, this is the first study to employ HIIT tele-exercise as an intervention for individuals with obesity and compare the fidelity of an exercise prescription to traditional in-person exercise training. We found exercise attendance decreased over time prior to the pandemic over a period of 72 weeks. However, this trend was reversed once tele-exercise sessions were introduced, indicating the possible effectiveness of supervised telehealth in maintaining engagement and participation among individuals with obesity. We observed a small negative effect of tele-exercise on exercise intensity compared with in-person exercise; however, the effect was minimal. Therefore, tele-exercise can lead to improved attendance without having a meaningful adverse effect on exercise intensity during those sessions in patients with class II/III obesity.

Attendance

Poor attendance and high dropout rates are prevalent among in-person exercise studies in adults with obesity, due to barriers such as time constraints, socioeconomic constraints, mood, and/or lack of enjoyment.[19] In our study, we also observed decreased attendance during the in-person supervised exercise study period, consistent with behavioral fatigue that can occur over time.[20] However, we found that attendance improved after transitioning to tele-exercise and no longer decreased during follow-up (Fig. 2A). Therefore, attendance was greater for supervised tele-exercise sessions compared with in-person sessions. Tele-exercise interventions have shown favorable attendance rates across various clinical populations,[21-24] but few studies compare them to in-person exercise interventions. One previous study compared in-person and tele-exercise attendance rates for individuals with obesity and found that bariatric surgery candidates maintained higher attendance rates over a 12-week period with tele-exercise compared with in-person exercise training in the form of endurance or strength training.[24] Our study extends this important finding to HIIT interventions in those with stage II/II obesity.

Heart Rate

The secondary objective was to compare exercise intensity by calculating the average of 10 peak training HRs as a percent of HRmax, between tele-exercise and in-person exercise training. Participants regularly trained at high intensities, reaching 80% to 90% of their HRmax during both in-person and tele-exercise study periods and no differences were observed before and after the pandemic (Fig. 3). However, exercise intensity slightly increased over time before the pandemic and slightly decreased over time after the pandemic. This aligns with findings from Baillot et al,[24] who found that tele-exercise intensity was comparable to the control group, which consisted of individual lifestyle counseling sessions every 6 to 8 weeks. In another study, patients with cardiometabolic comorbidities who were randomized to a 12-week tele-exercise intervention exhibited a significant increase in vigorous-intensity physical activity compared with the usual care group.[25] Collectively, these studies suggest that tele-exercise does not compromise the intensity of exercise sessions.

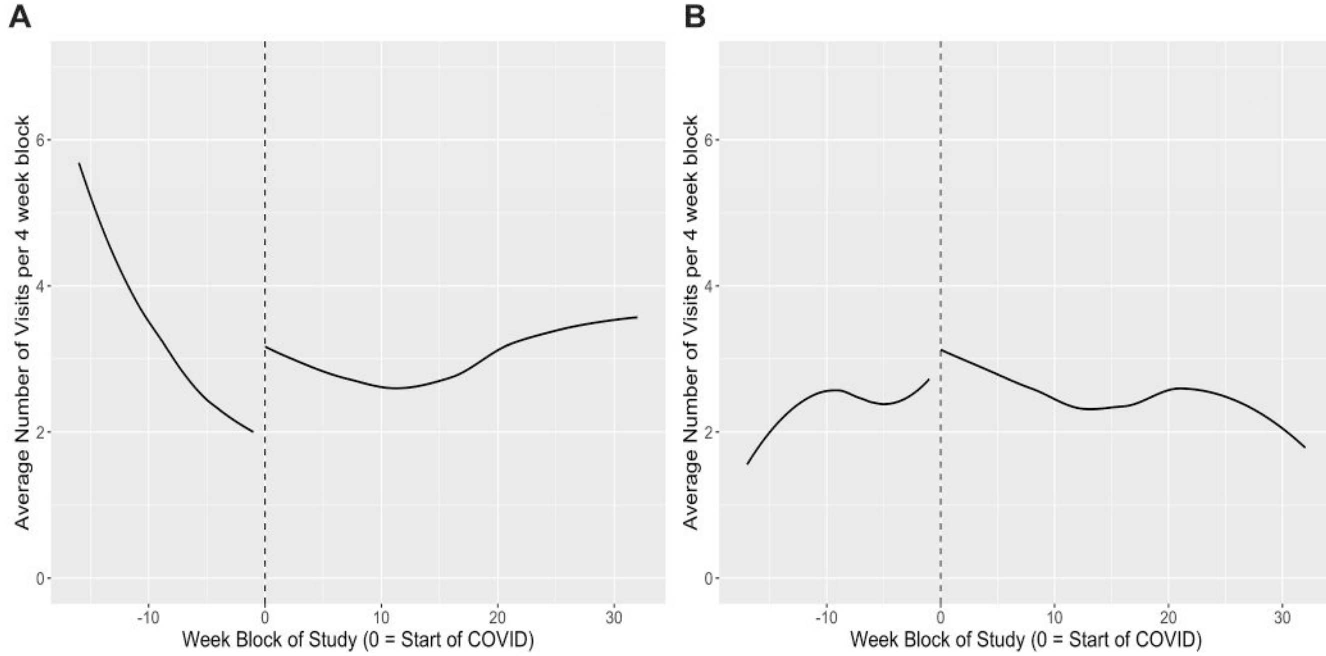

Fig. 2. Predicted number of high-intensity interval training sessions over time. *A*, Supervised sessions. *B*, Unsupervised sessions.

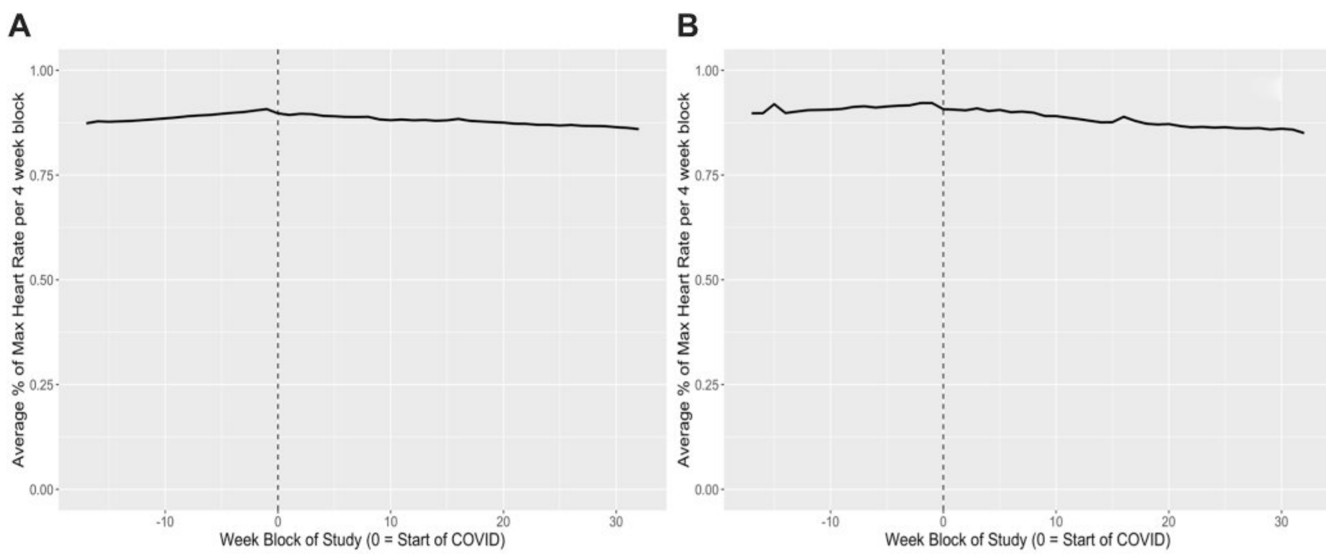

Fig. 3. Predicted average % of maximum heart rate over time. *A*, Supervised sessions. *B*, Unsupervised sessions.

Covariates

We found that employment, prediabetes/diabetes, and female sex reduced exercise attendance, whereas older age and post-bariatric surgery status increased attendance (Table 2). This challenges previous studies which found unemployment to be closely linked with poor exercise adherence based on survey data.[26,27] The disparity could be explained by time constraints of employed individuals, leading to lower attendance. Our finding that prediabetes and diabetes were associated with decreased exercise attendance aligns with a large (n = 12,007) study of cardiac rehabilitation patients, which found that diabetes and prediabetes were associated with poor exercise attendance among individuals with obesity.[28] One possibility for this finding is that participants with prediabetes or diabetes have an increased likelihood of having diabetes-related complications such as neuropathy, which might deter to exercise attendance, perhaps due to increased foot pain or fear of falls.[29] Our results indicate the need to determine facilitators and barriers specific to individuals with prediabetes and diabetes to tailor exercise interventions for their specific needs. Our finding that younger age and female sex were associated with decreased exercise attendance requires further investigation in larger populations. It is possible that older individuals in our study had more flexibility in their schedules, enabling them to adhere to a HIIT program more effectively than younger participants. Overall, few patient factors influenced the ability of our patients to meet their prescribed intensity targets, indicating that HIIT can be successfully delivered to a diverse population with obesity. Future studies examining other potential characteristics that may influence exercise attendance, such as socioeconomic status, social support, or mental health comorbidities, could provide valuable insights.

Implications

This study suggests that tele-exercise could cut costs and improve access for patients facing logistical challenges, potentially enhancing adherence due to affordability.[30] However, technology is a prerequisite for tele-exercise.[24] Although socioeconomic factors may influence telehealth usage, this study minimized these by requiring only telephone access, rather than high-speed internet, and bodyweight exercises or common household items if patients did not have access to exercise equipment or a gym. Therefore, we were able to demonstrate the positive effects of tele-exercise on attendance and exercise intensity in those at different socioeconomic levels. Beyond the evident health advantages, utilizing tele-exercise not only eases patient burdens but could reduce the carbon footprint, contributing to a more sustainable health care model.[31]

Strengths and Limitations

A notable strength of the study is the collection of data from 3 large institutions which serve diverse populations (academic suburban, academic urban, and community). Additionally, the use of wearables facilitates objective measurement of exercise attendance and intensity, whereas previous studies rely on self-report measures.[32,33] There are, however, several limitations to this study. First, this is a substudy of a randomized clinical trial performed for other purposes. Additionally, patients were not randomized to in-person versus tele-exercise sessions, which could lead to inherent confounding by unobserved variables, such as personal factors (self-efficacy, enjoyment, etc.), environmental factors (social support, disruptions in exercise, stable internet connection, etc.), and other unmeasured confounding variables.[19,34,35] In addition, the sample size of this study was relatively small. Furthermore, all participants had obesity, and most participants were female (82.3%), White (74.2%), non-Hispanic (98.4%), and employed (82.3%). Thus, future studies are needed to determine whether our findings regarding exercise attendance and intensity in tele-exercise training are generalizable to populations without obesity, or among predominantly male, non-White, Hispanic, and/or unemployed populations. However, this distribution is typical of individuals seeking bariatric surgery.[36] Another limitation is that the generalizability outside of individuals seeking bariatric surgery remains unknown. Finally, the COVID-19 lockdown may have artificially boosted exercise adherence due to increased free time and limited activities. Given that all patients transitioned to tele-exercise during the COVID-19 pandemic, we were unable to determine whether the increases to exercise attendance were due to the pandemic or the transition to supervised tele-exercise. Thus, future studies are needed to determine whether tele-exercise increases exercise attendance compared with in-person exercise postpandemic.

Conclusion

The COVID-19 pandemic led to an exponential rise in telehealth use. Additional studies must evaluate the feasibility and efficacy of tele-exercise interventions and identify areas for improvement. Our study demonstrates that tele-exercise is a viable intervention for individuals with obesity given that the intensity of exercise does not meaningfully differ from traditional in-person training, while attendance impressively increased over time. Further study of this topic is crucial for expanding the use and accessibility of tele-exercise.

Disclosure

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Author Contributions

L.C. was involved in conceptualization, methodology, resources, data curation, writing, reviewing & editing, visualization, and project administration. M.W. was involved in conceptualization, methodology, software, formal analysis, resources, data curation, writing, reviewing & editing. E.L.R. was involved in conceptualization, methodology, software, validation, formal analysis, resources, data curation, reviewing & editing, supervision, funding acquisition. D.K. was involved in conceptualization, methodology, reviewing & editing. J.F.H. was involved in conceptualization, methodology, reviewing & editing. J.M.H. was involved in conceptualization, methodology, review & editing. E.C. was involved in conceptualization, methodology, project administration, investigation. M.B. was involved in conceptualization, methodology, review & editing. B.C.C. was involved in conceptualization, methodology, validation, formal analysis, resources, data curation, review & editing, supervision, funding acquisition.

Ethics Approval and Participant Consent

This study received University of Michigan Institutional Review Board approval (HUM00143541). All study participants provided written informed consent.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Clinical Trial Registration

clinicaltrials.gov: NCT03617185 (https://clinicaltrials.gov/study/NCT03617185)

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