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Recent Progress in Nutrition

Research Article

Chair Fitness Program for Improved Strength and Physical Function for Older Adults: A Pilot Comparative Effectiveness Study

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Academic Editor: Monica C. Serra

Special Issue: Exercise Training and Nutritional Modification to Optimize Health in Older Adults

Recent Progress in Nutrition
2023, volume 3, issue 3
doi:10.21926/rpn.2303016

Received: July 05, 2023
Accepted: September 03, 2023
Published: September 12, 2023

Abstract

Within the US, people are experiencing longer life expectancy, yet these extended lifespans have not necessarily translated into years living in good health. Musculoskeletal degenerative diseases are particularly prevalent amongst older adults. Research shows that regular resistance exercise carries preventive health benefits to combat these conditions. This study evaluated the impact of an innovative hand-held device (OYO) on the physical function of older adults compared to a traditional chair fitness program (CF) and no exercise control (CG). Participants (n = 48) were 60 years old and older, retirement community residents with no

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current history of chronic conditions, who possessed the ability to follow guided exercise. Participants elected to the OYO, CF or CG groups. The exercise program was 45 minutes, twice a week for 9 weeks. The CF group used standard gym equipment while the OYO group utilized a hand-held device capable of multi-planar movements and varying resistance. Various pre-post measures of physical function were recorded. Preliminary data suggests that there was a significant positive difference between the study group for biceps strength test $F(2, 39) = 3.49$ $p = 0.04$, $h^2 = 0.15$), 30-second chair stand ($F(2, 37) = 3.60$, $p = 0.04$, $h^2 = 0.16$) and a 2-min step test ($F(2, 39) = 3.27$ $p = 0.05$, $h^2 = 0.14$). A Tukey-HSD test showed a positive trending, however, not significant effect for 30-second chair stand and latissimus strength test ($p = 0.08$ and 0.06, respectively) between the OYO and CF groups. The two groups had equivocal post-intervention results on all other measures. In conclusion, our results suggest this hand-held device is as or more efficacious as a traditional resistance program that utilizes several pieces of equipment. Widespread adoption of this device could reduce program costs and improve access to quality fitness opportunities for older adults.

Keywords

Resistance training; exercise; intervention; retirement community; hand-held device

1. Introduction

In the US, people are experiencing longer life expectancy than ever before, yet these extended lifespans have not necessarily “translated into corresponding increases in years living in good health” [1]. It is estimated that 85% of Americans over the age of 65 are living with one chronic health condition and 56% of these, with two or more [2]. The importance of engaging in regular physical activity to reduce poor health outcomes is well documented [3]. Physical activity is widely recognized as conferring significant health benefits to older adults including but not limited to, reduced risk of chronic diseases (e.g., diabetes, cardiovascular disease), positive mental health and management of existing conditions [4, 5]. Conversely, physical inactivity amongst older adults is associated with increased risk of cardiovascular disease mortality, reduced musculoskeletal health, increased functional limitations, reduced quality of life (QoL) and increased risk of cognitive decline, dementia and Alzheimers [6, 7].

Considering these trends, the World Health Organization (WHO) recently issued new guidelines for physical activity [8]. These guidelines have subsequently been endorsed by the Health and Human Services Physical Activity Guidelines for Americans Advisory Committee [9]. According to these guidelines it is strongly recommended that older adults meet 3 minimum physical activity targets per week. The current physical activity recommendations for older adults aged 65+ encourage this population to complete i) at least 150-300 min of moderate-intensity aerobic physical activity, or at least 75-150 min of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate-intensity and vigorous-intensity activity throughout the week for substantial health benefits, ii) Muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits and, iii) Varied multicomponent physical activity that emphases functional balance and strength training at moderate or greater intensity on 3 or more days a week, to enhance functional capacity and to prevent falls [8, 9]. The guidelines also encourage older adults to "limit the amount of time spent being sedentary", replace sedentary time with "physical activity of any intensity (including light intensity)" and "do more than the recommended levels of moderate to vigorous-intensity physical activity" to reduce the detrimental effects of high levels of sedentary behavior on health [8].

Research has explored a host of different interventions designed to engage older adults in physical activity including but not limited to, mobile health apps [10] and group classes [11] across a range of settings including community and/or fitness centers [12], home-based [13] and clinical settings [14, 15]. These interventions have primarily focused on the use of resistance training to reduce risk factors associated with falls (e.g., balance and stability) [16], improve cognitive function [17] and act as a "countermeasure to age-related chronic diseases" [18]. Their findings have led the Strength and Conditioning Association to conclude that resistance training is:

> A powerful intervention to combat the loss of muscle strength and muscle mass, physiological vulnerability, and their debilitating consequences on physical functioning, mobility, independence, chronic disease management, psychological well-being, quality of life, and healthy life expectancy [19].

Within these programs, chair-based activities [20-23] and traditional weight training equipment (e.g., resistance bands, free weights and weight machines) [24-28] are most commonly used to promote physical activity amongst older adults. Modifications and alternatives to the training structure [29, 30], exercise order [31], velocity of exercise [32, 33], and type of muscular contraction [34] have all be evaluated. However, non-traditional approaches involving mobile applications (e.g., Bingocize®) or innovative handheld resistance exercise devices (HRED) (e.g., OYO DoubleFlex) have recently entered the market to enhance traditional programming. While researchers have begun to explore the efficacy of these new interventions in relation to their impact on cognitive and/or physical function [35, 36], studies have yet to compare the outcomes of these programs against traditional older adult exercise programming. Consequently, it is the primary purpose of this paper to compare the physical function outcomes of one HRED training program against traditional older adult exercise programming (e.g., chair fitness/resistance bands/free weights. We hypothesize that the HRED training program will produce equivocal results to a traditional chair-based exercise program. By testing this hypothesis, this paper seeks to improve future programming for older adults by reducing the volume of equipment needed to achieve positive health gains, shortening the learning curve associated with multiple resistance exercise equipment, and reducing the cost of equipment for community-based programs.

2. Materials and Methods

2.1 Participants

Older adults (age >60 years) who lived at a non-profit retirement community, or who lived local to the community and exercise at its Aquatic & Fitness Center, volunteered to participate in the study. Participants were recruited through posted flyers and a snowball approach. Eligibility requirements included being 60 years of age or older with self-assessed ability to complete at least 30 minutes of guided exercise, standing or seated. Individuals with a history of severe heart disease, musculoskeletal conditions, asthma, diagnosed cognitive impairment, or recent surgery were excluded. Forty-eight individuals met the inclusion criteria (mean age 77.99 ± 7.48 years, 13 men and 35 women).

Participants were allocated to one of three groups via self-selection based on the schedule of classes and their availability. One class was advertised to be offered Mondays and Wednesdays, the other on Tuesdays and Thursdays. Participants selected one of two classes, OYO Gym group (OYO) or Chair Fitness (CF), that worked for their individual schedules. Those who could not accommodate or commit to either class were invited to be in the Comparison Group (CG).

2.2 Exercise Program Intervention

For this study, the OYO and CF groups completed an identical exercise program consisting of 18 classes spread out over nine weeks (2 classes each week). Type of exercise, frequency, intensity, time, and instruction were fully equivalent, as both groups followed the same exercise curriculum and were taught by the same team of four certified fitness instructors [30]. The notable difference between the OYO and CF groups was the equipment used to perform the exercises. In the OYO group, the only piece of equipment utilized was the OYO Gym SE (OYO Fitness, Van Nuys, CA, USA), a lightweight hand-held resistive exercise device capable of multi-planar movements offering varying degrees of resistance between 5 to 25 pounds in five-pound increments (see Figure 1).

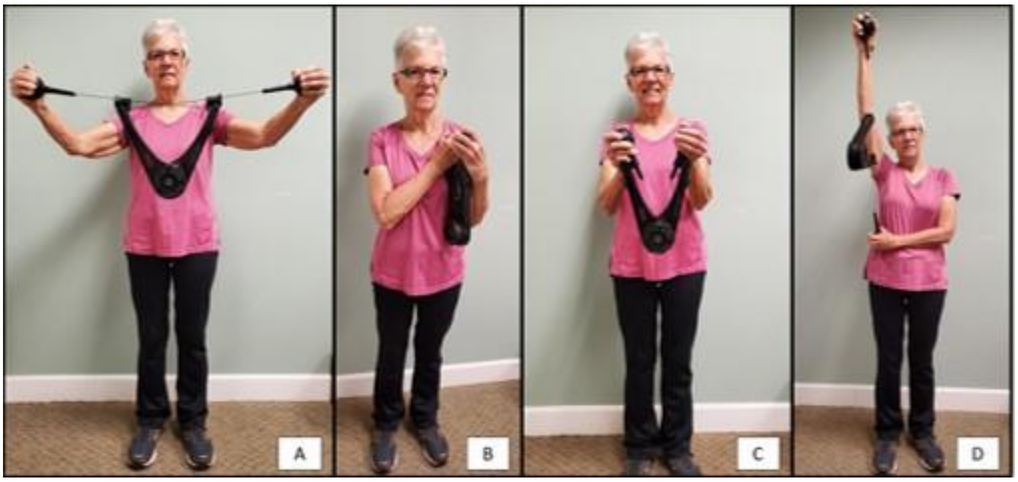

Figure 1 Examples of OYO Gym SE exercises. The figure depicts the OYO Gym SE utilized in the OYO group. Examples of the various configurations include (A) back pull, (B) bicep curl, (C) chest press, and (D) shoulder press.

Preliminary evidence suggests that the OYO is an acceptable fitness device within this population [36]. The CF group completed identical exercises using resistance bands, dumbbells, and exercise balls. Participants in both classes were instructed to sit or stand according to their preference, as is common in older adult chair fitness classes.

The exercise curriculum used for both groups was originally designed to teach older adults how to use the OYO Gym SE while simultaneously encouraging increases in strength, flexibility, and stamina. Because the OYO Gym SE is a novel device, older adult participants needed to learn how to hold, stabilize, and use it correctly to complete more than three dozen different exercises. Accordingly, the complexity and challenge of classes increases as the class progresses in knowledge, skill, and strength from one week to the next.

Although the curriculum was originally designed to be taught with the OYO Gym SE, the nature of the exercises is such that they can be completed alternatively with different pieces of equipment such as dumbbells, bands, and exercise balls. However, because OYO Gym users require a learning period that necessitates the use of minimal resistance (in order to master form before concentrating on effort), to control for potential differences in resistance due to the assumed familiarity of the CF group with its equipment (e.g., dumbbells and bands) versus the OYO group with the OYO Gym, both groups were asked to use light weight (≤5 pounds) for the first four classes, during which correct form for a number of exercises was taught. Instructors were also asked to treat both groups identically in terms of teaching them the correct name and function of each exercise, regardless of which type of equipment was used. At the fifth class and onward, Instructors invited participants to increase resistance as they desired.

Group fitness classes lasted 45 minutes including a warm-up, 30 to 35 minutes dedicated to exercise, and a cool down. The exercise curriculum is progressive in nature inclusive of full-body large-muscle group exercises [36]. As previously mentioned, the first four weeks were a familiarization period. Weeks five through seven prioritized exercise over instruction with the introduction of combination exercises that scaled from least to most challenging. Learning became the focus again in week eight with the introduction of new exercises, and week nine's focus shifted back to exercise with sessions that included exercises learned from all previous weeks.

2.3 Functional Measures

The overall organization of the research project was such that a pre-test assessment measuring a range of biometrics associated with older adult functional fitness occurred one week prior to the first week of exercise instruction. A post-test assessment was conducted the week after the final group fitness class. The CG group completed pre- and post-testing at the same time as the intervention groups. The pre/post testing was conducted by an assessment team containing staff members from the host retirement community and student researchers from the 3rd author's institution. The assessment team comprised of kinesiology students who underwent approximately 6-10 hours of training on the assessment tools and procedures described below.

2.3.1 Bicep Strength Test [37]

Bicep strength was assessed through a seated bicep curl performed with a handgrip attached to a calibrated digital scale [Crane Scale WH-C300L, Weiheng Electronics Company, Guangzhou, China] mounted to a floorboard. Participants sat on the edge of a chair with their backs straight and feet flat on the floor. To start, the handgrip was positioned at the individual's side and in the dominant hand with the arm relaxed. On cue, the participant curled the handgrip up, exerting as much pressure as possible. The tester counted "1, 2, 3" and on "3" pressed the hold button on the scale to record maximum resistance. This was performed three times; the largest number of the three attempts was recorded.

2.3.2 Latissimus Strength Test [38]

Strength of the upper back was assessed at a standard lateral pull down machine. The machine was set to maximum weight (200 lbs.) and a strap, calibrated digital scale, and bar were attached.

The seat was adjusted for each participant such that feet were flat on the floor and knees were at 90 degrees, held firmly in place by a knee pad. Participants grabbed the bar in a wide grip and were instructed to drive elbows down and out, pulling as hard as possible, even though the bar would not come down toward them. A trial run was given to check for proper form and understanding, and corrections were given as necessary. The tester said, “go” at which point participants pulled down with as much strength as possible. During exertion, the tester counted “1, 2, 3” and on “3” pressed hold on the scale to record the resistance. This was performed three times; the largest number of the three attempts was recorded.

2.3.3 30-Second Chair Stand [39]

This assessment measured lower body strength. A chair was placed against a wall to prevent slipping. Participants sat in the middle of the seat with feet flat on the floor and arms crossed at the wrist and held against the chest. Participants were instructed to complete as many full stands as possible in 30 seconds, counting one rise and return to the seat as one repetition. The total number of completed repetitions within 30 seconds was recorded.

2.3.4 Sitting-Rising Test [40]

This assessment was used to measure flexibility, balance, and muscle strength. A mat was placed on the floor. Participants were given the following instruction: “Without worrying about the speed of movement, try and sit and then rise from the floor, using the minimum support that you believe is needed to do so.” A maximum of 10 points were possible: 5 for sitting and 5 for rising without any support. Each support used (e.g., a hand, forearm, knee, side of leg, hand on knee, etc.) removed 1 point. Participants could also lose half a point for perceived unsteady performance, which was demonstrated by the tester. Testers gave the instruction to start and carefully monitored all movement from sitting to standing, arriving at a recorded score.

2.3.5 Back Scratch Test [39]

Upper-body flexibility was assessed with this measure. While standing, participants placed their preferred hand palm down with fingers extended, over the same shoulder, reaching down their backs as far as possible. Their other arm went around the back of the waist with the palm up, reaching as far up as possible to try and touch or overlap the distance between the middle fingers on both hands. Participants were instructed against grabbing fingers and pulling hands together. Two practice trials were given to determine which arm to use above and below. Then two official trials were given and the best score of the two was recorded. Scores resulted by measuring the distance of overlap of, or distance between, the middle fingers. If fingers did not touch, a negative score was given based on their distance. A score of zero was given to those who touched middle fingertips but did not overlap. A positive number was given for fingertips overlapping, based on how much overlap resulted. Measurements were made with a ruler and points awarded by the half-inch.

2.3.6 2-Minute Step Test [39]

To assess aerobic endurance, participants were asked to stand up straight next to a wall on which a piece of tape was placed at a level between each participant’s patella and iliac crest. Participants were then asked to march in place for two minutes, lifting the knees to the height of the tape. Resting was allowed, as well as placing a hand on the wall or a chair situated in front of them for purposes of balance. The assessment concluded at 2-minutes and the total number of times that the right knee reached the level of the tape was recorded.

2.4 Other Measures

Secondary measures and demographic information included recording each participant's age, height, weight, gender, and blood pressure (as measured by an attending nurse or other trained technician). Body mass index (BMI) was calculated using weight in pounds divided by height in inches squared and then multiplied by 703.

2.5 Statistical Procedures

Means and standard deviations are given as descriptive statistics. Statistical analyses were performed with the SPSS statistical software (Version 27, IBM Corporation, Armonk, NY, USA). Before the analysis, assumptions of equality of variances and normality were made. Group means differences in Bicep Strength Test, Latissimus Strength Test, 30-Second Chair Stand, Sitting-Rising Test, Back Scratch Test, 2-Minute Step Test, and Group Exercise Survey among the study groups were determined using a one-way analysis of variance (ANOVA). For multiple comparisons among the groups, the Tukey HSD post hoc test was used to determine the sources of the difference. Statistical significance was set at $P < 0.05$. In addition, within group differences for Bicep Strength Test, Latissimus Strength Test, 30-Second Chair Stand, Sitting-Rising Test, Back Scratch Test, 2-Minute Step Test, and Group Exercise Survey within the study groups was determined by a paired t-test. Partial eta-squared was utilized to evaluate the proportion of variance explained by group effect.

Approval to conduct research with Human Subjects was obtained through the Institutional Review Board of the University of La Verne, California (IRB document #: 2018-99-CAS). The methodology, data analysis and reporting of data all align with the requirements of the Belmont Report.

3. Results

3.1 Baseline Characteristics of Participants

Demographic and baseline characteristics of the total participants (N = 48) are presented separately by group in Table 1. Baseline characteristics show that the OYO fitness group was significantly younger as compared to the CF ($p < 0.01$) and CG ($p < 0.01$). In addition, the CF group was significantly weaker in the biceps strength test as compared to the CG ($p = 0.01$). Lastly, the OYO group had significantly more chair stand test repetitions as compared to group means ($p = 0.04$), however, no individual group differences were significant.

Table 1 Demographic characteristics of participants (n = 48).

GROUP	OYO FITNESS		CHAIR FITNESS		CONTROL		
CHARACTERISTIC	**N**	**M (SD)**	**N**	**M (SD)**	**N**	**M (SD)**	**P-Value *p < 0.05**
AGE	15	72.4(6.3)	16	81.5(6.4)	17	79.7(6.9)	**0.001***
HEIGHT (INCHES)	15	64.5(2.6)	16	54.5(41.1)	17	67.2(3.4)	0.287
WEIGHT (POUNDS)	15	164.8(45.1)	15	150.3(30.1)	17	177.0(26.8)	0.105
SEX	15		16		17		0.278
FEMALE	12		13		10		
MALE	3		3		7		
SBP (MMHG)	15	133.7(15.8)	16	134.5(13.5)	17	131.8(14.2)	0.855
DBP (MMHG)	15	74.3(6.2)	16	71.75(6.5)	17	73.1(7.3)	0.585
BICEPS STRENGTH TEST (LBS)	15	27.1(8.1)	16	19.6(7.7)	17	29.7(11.9)	**0.011***
LATISSIMUS STRENGTH TEST (LBS)	15	82.6(29.9)	15	60.6(38.2)	17	70.3(31.1)	0.203
CHAIR STAND TEST (COUNT)	15	17.2(9.4)	16	11.13(5.7)	16	11.8(5.3)	**0.040***
SITTING RISING TEST(POINTS/10)	15	3.7(2.4)	16	3.2(2.4)	16	2.2(1.4)	0.145
BACK SCRATCH TEST (INCHES)	15	-4.4(5.0)	15	-5.1(3.7)	15	-6.3(6.8)	0.601
2-MIN STEP TEST (COUNT)	15	70.2(22)	16	58.8(24.5)	17	54.7(20.1)	0.140

3.2 Effects of Intervention Program on Physical Fitness Outcomes

The one-way analysis of variance (ANOVA) showed that there were improvements in the latissimus strength test across all three groups: OYO ($p < 0.01$), CF ($p < 0.01$), and CG ($p < 0.01$). In addition, improvement in the 2-minute step test was seen in the OYO ($p = 0.03$) and CF ($p < 0.01$) groups. The comparative results suggest that there are no group differences between the OYO, CF and CG for the latissimus strength test ($p = 0.07$), sit-and-rise ($p = 0.10$) and back-scratch ($p = 0.16$) tests. However, there is a significant positive difference between groups for the biceps strength test ($F(2, 39) = 3.49$, $p = 0.04$, $h^2 = 0.15$), 30-second chair stand ($F(2, 37) = 3.60$, $p = 0.04$, $h^2 = 0.16$) and a 2-min step test ($F(2, 39) = 3.27$, $p = 0.05$, $h^2 = 0.14$). A Tukey-HSD post hoc test showed a positive trending, however, no significant effect for the 30-second chair stand and latissimus strength test when comparing OYO to CF class ($p = 0.08$ and 0.06, respectively) (Table 2).

Table 2 Effects of intervention program on physical fitness outcomes.

GROUPS	OYO (N = 15)			CHAIR FITNESS (N = 16)			CONTROL (N = 17)		
CHARACTERISTIC	PRE	POST	P value	PRE	POST	P-value	PRE	POST	P-value
WEIGHT (POUNDS)	164.8(45.1)	165.7(46.7)	0.231	150.3(30.1)	145.9(25.7)	0.620	177.0(26.8)	173.5(30.0)	0.212
SBP (MMHG)	133.7(15.8)	134.5(10.1)	0.729	134.5(13.5)	129.9(11.8)	0.191	131.8(14.2)	128.3(10.8)	0.743
DBP (MMHG)	74.3(6.2)	73.1 (7.1)	0.568	71.8(6.5)	71.7(8.9)	0.926	73.1(7.3)	73.1(9.7)	0.773
BICEPS STRENGTH TEST (LBS)	27.1(8.1)	27.6(8.5)	0.667	19.6(7.7)	22.3(7.1)	0.095	29.7(11.9)	30.8(10.2)	0.847
LATISSIMUS STRENGTH TEST (LBS)	82.6(29.9)	110.5(44.7)	**0.002***	60.6(38.2)	78.3(33.0)	**0.004***	70.3(31.1)	95.9(21.2)	**0.001***
CHAIR STAND TEST (COUNT)	17.2(9.4)	16.5(6.3)	0.692	11.1(5.7)	11.9(4.5)	0.593	11.8(5.3)	11.3(5.6)	0.169
SITTING RISING TEST(POINTS/10)	3.7(2.4)	4.9(2.7)	0.223	3.2(2.4)	3.1(2.5)	0.150	2.2(1.4)	2.9(2.3)	0.183
BACK SCRATCH TEST (INCHES)	-4.4(5.0)	-2.9(4.0)	0.116	-5.1(3.7)	-5.9 (5.0)	0.619	-6.3(6.8)	-6.7(6.3)	0.601
2-MIN STEP TEST (COUNT)	70.2(22)	84.7(21.2)	**0.029***	58.8(24.5)	82.9(18.3)	**0.001***	54.7(20.1)	63.1(32.7)	0.170

4. Discussion

4.1 Results Summary

Physical fitness is an important component of overall quality of life in older adulthood [41-43]. In particular, research underscores the importance of functional fitness-the physical ability to complete movements needed in everyday life – for improvement in overall quality of life [44-48]. This is typically measured via parameters including muscular strength, aerobic endurance, flexibility, agility and balance, and BMI [44]. Our study aimed to assess these aspects of older adult functional fitness after completing a traditional CF program, OYO program, or no fitness program (CG). Our results suggest that the CF and OYO programs significantly improve aerobic fitness, measured by the 2-min step test, compared to CF. Our results also suggest trending improvements in favor of the CF and OYO groups in biceps strength, and 30-second chair stand. All together these results suggest that the OYO Gym SE may be a viable alternative to standard free weights.

Significant between-group increases were measured for biceps strength test, 30-second chair stand, and the 2-minute step test in both the OYO and CF groups compared to the CG. Our results support meta-analysis results that suggest that chair-based exercises produce the largest effect on biceps strength (mean difference 2.82) and 30 second chair stand test (mean difference 2.25) [49]. The Tukey-HSD analysis indicated that the OYO group resulted in greater improvements in 30-second chair stand, although the results were not statistically significant.

The improvements in 2-minute step tests observed in the current study suggest that both OYO and CF improved aerobic capacity of participants which conflicts with systematic review results that does not suggest chair-based exercises improve aerobic performance [50]. However, other literature suggests the opposite [51]. Meta-analytic results suggest that concurrent style training, a mix of resistance training and aerobic training, is best to improve cardiovascular fitness in older adults [52]. Our observed may have been due, at least in part, to the choice of aerobic test conducted. Unlike other commonly used aerobic tests that require a significant amount of space [44], the 2-minute step test is a relatively stationary exercise that requires both endurance and functional strength. The observed improvements in the 30-second chair stand suggest that the participants in the OYO and CF group increased their lower extremity functional strength which would also contribute to their performance in the 2-minute step test.

Although not statistically significant, both groups saw scoring improvements in a majority of measures that surpassed 0.2 SD of the baseline value, which is clinically relevant and meaningful [44, 53]. The OYO group saw post-test improvements in five out of six functional assessments and the CF group measured improvements in four out of the six assessments. As previously stated, the OYO group's improvements in 30-second chair stand compared to the CF group trended higher. Additionally, there was a trend toward significantly different values in post-test latissimus strength in favor of the OYO group. This observation adds to the research evidence that chair-based fitness programs may lead to increased upper limb flexibility and strength [49].

Our results suggest that the OYO group yields comparable results to the traditional CF group which adds to the literature of equivalency exercise programs for older adults. The difference between the two intervention groups in the current study was the type of resistance device used; standard free weights and resistance bands or a single resistance device with varying resistance and configurations. This is a new comparison among older adult populations as previous research compared the resistance training structure (functional vs. traditional [29, 30]), exercise order [31], velocity of exercise [32, 33], type of muscular contraction [34]. Most of the literature suggests that differences in training lead to equivocal results with some exceptions. One of the exceptions being eccentric exercises leads to greater improvements in physical function in older adults compared to concentric exercises [34]. This may put a preference of the OYO Gym SE over traditional equipment as it required a degree of eccentric control from antagonist muscles to maintain the device configuration during concentric activity. However, this needs to be investigated further.

4.2 Implications

Our results suggest that the OYO group yields comparable results to a traditional CF. This has potentially significant implications for the field of older adult fitness, and particularly for challenging traditional chair-based fitness as the preeminent method of meeting older adult fitness needs. There are multiple reasons for this. First, the OYO Gym SE is lighter, weighing significantly less than dumbbells, yet offering between 5 and 25 pounds of resistance. This results in the OYO Gym being easier to hold and use, which can reduce hand fatigue and promote better control of the device during exercise. Older adults are more prone to injury due to strength training than most younger groups [54]. Using a piece of exercise equipment that weighs only two to three pounds while offering 5, 10, 15, 20, or 25 pounds of resistance may reduce risk of injury.

Second, the design of the OYO Gyms SE helps users stabilize form. This is accomplished by the cables attached to the device which restrict improper movement and aid with returning to the starting point of all expansion-based exercises (i.e., Shoulder Press). Because proper form is essential for reducing risk of injury in strength training [54], and because shoulder joints are more likely to be injured in older adults through exercise attempted with improper form [55], the use of the OYO Gym SE may simultaneously reduce risk of injury and promote better exercise results than the use of free weights such as dumbbells.

Third, from a strictly pragmatic perspective, facilities that cater to older adult clients, such as gyms, community centers, and retirement communities, may find it fiscally advantageous to purchase one piece of hand-held equipment that can provide a number of upper- and lower-body exercises at different resistance levels, than purchasing multiple sets of dumbbells, bands, and other free weights in varying resistances. This would have implications not only for finances and use, but also for storage, as fewer pieces of exercise equipment would need to be available on site.

Finally, although our study did not address this aspect, some research does support the idea that the novelty inherent in the use of the OYO Gym SE, which is unlike anything most older adults have exercised with before, provides positive and protective stimulation to the aging brain [56, 57]. Learning how to use the piece of equipment may well double the benefit to the older adult user: exercising not only the body, but the brain. As mental well-being is of prime importance to most older adults [58], this is a significant consideration that warrants additional research.

4.3 Strengths and Limitations

4.3.1 Limitations

The current study is not without its limitations. Participants self-selected into the study groups based on their availability and when the fitness programs (OYO or CF) were offered which resulted in a non-randomized study design. Sample size was based on a convenience sample (residents of the retirement home), availability of equipment, and resources. The OYO participants were significantly younger than the participants in the two other study groups. This is a notable limitation as it has been observed that age interacts with fitness improvements, favoring younger individuals [59]. While we report positive trends among the OYO group, the magnitude of that effect may be influenced by age. Moreover, the assessor that measured participant physical function was not blinded to the participant's study group. In an effort to reduce assessor bias, the statistical analysis was performed by a blinded researcher.

The study took place at a non-profit retirement community that had previously utilized the OYO Gym SE in their fitness programming. Participants that previously used the OYO device or previously enrolled in a CF program were not excluded. This may have resulted in inflated baseline measurements in physical function. The improvements in physical function observed, while clinically significant, were marginal. This may be due to the fact that the intervention groups used a very light resistance load in the first four weeks to allow for familiarization within the OYO group. A familiarization period is a standard practice in resistance training [29], but it typically less than the 4-weeks used in the current study. At the fifth class and onward, Instructors invited participants to increase resistance as they desired. However, the research team did not record individual participant resistance load therefore we cannot determine if variations in resistance impacted the outcomes. Lastly, the current study was limited by the sample size. Although significant changes were observed, the study was not powered to detect changes across all physical function measures. The reported effect sizes can be used in future studies to determine the effectiveness of an OYO program.

4.3.2 Strengths

Despite the stated limitations, this study has several strengths. The OYO Gym SE that was utilized was previously assessed for efficacy and acceptability within the same target population [36]. This study expanded upon preliminary research that did not compare the efficacy results to exercise programs. Our results provide evidence that the OYO program is not only efficacious, but it may produce comparable results to a traditional chair-based fitness program. The design of the fitness program is also a strength of the study for the exercise curriculum accounted for the learning curve of using the novel device. Participants spent the first four weeks familiarizing themselves with the workouts and the equipment.

5. Conclusions

In this study, we compared the physical function outcomes under three conditions: OYO, CF, and CG. The CF group completed a traditional chair fitness program while the OYO group completed a fitness program identical in structure but utilized a HRED (OYO Gym SE). The CG did not take part in any fitness program. After 9-weeks there was a significant improvement in biceps strength, 30-second chair stand, and 2-minute step tests in the OYO and CF group. The comparable results suggest that the OYO is a viable alternative to older adult fitness. The potential benefits of replacing traditional chair-based fitness programs with the OYO include less required equipment, improved exercise form, reduced financial and storage burden, and mental stimulation. These potential benefits along with the effectiveness of broadly implementing such a program require further investigation.

Acknowledgments

The authors would like to acknowledge the support of OYO Fitness®, Hillcrest Retirement Community, and University of La Verne (Kinesiology Department in the College of Health and Community Well-Being) for their support of this study.

Author Contributions

RNH and BDC designed and managed the study and collected the data. ATA analyzed the data. RNH, ATA, LK, and ZHL wrote the manuscript. All authors read and approved the final manuscript.

Funding

OYO Fitness® supplied the OYO Gym SE equipment for the study. The funding source had no role in the study design, data collection, management, analysis, interpretation, or preparation of the manuscript.

Competing Interests

The authors have declared that no competing interests exist.

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