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Investigating the Effectiveness of 12 Weeks of Kettlebell Training Compared to Bodyweight Resistance Training on Body Composition in Young Adult Males

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Abstract

This study compared the effects of bodyweight exercises with kettlebell resistance training on important body composition measures in male young adults. A passive control group was also included. Data from 18 young male participants, with an average age of (20.43±2.18) years, were included in the final analysis. The participants were divided into three groups at random: body weight resistance training group (BWRTG, n=6), kettlebell resistance training group (KRTG, n=6), and the control group (CG, n=6), which had no training. Body composition was evaluated through various metrics, including skeletal mass, body fat mass, body mass index, body fat percentage, waist-to-hip ratio, and visceral fat area. The 12-week progressive training programs for KRTG and BWRTG were structured with defined sets, repetitions, and intensity modifications. The results revealed that both the KRTG and BWRTG groups showed similar effects on body fat mass (p=0.032, ES=0.22; p=0.021, ES=0.29), body fat percentage (p=0.040, ES=0.22; p=0.037, ES=0.21), and visceral fat area (p=0.004, ES=0.36; p=0.002, ES=0.60). A significant improvement in the waist-to-hip ratio was observed in the KRTG group (p=0.036, ES=0.36), while no significant change was seen in the BWRTG group (p=0.036, ES=0.52). The results show that the 12-week KRTG and BWRTG regimens had comparable benefits on reductions in visceral fat area, body fat mass, and body fat percentage. These results indicate that both training methods are suitable for individuals aiming to enhance body composition, with kettlebell training providing an extra advantage in decreasing waist-to-hip ratio.

Keywords: *visceral fat reduction, skeletal muscle mass, waist-to-hip ratio, body composition improvement, resistance training benefits*

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Introduction

The rise of sedentary lifestyles in contemporary society has become a global health issue, contributing significantly to the increase in non-communicable diseases (Budreviciute et al., 2020; Singh et al., 2024; Uddin et al., 2020). Sedentarism, characterized by prolonged periods of physical inactivity, is now considered a major risk factor for chronic conditions such as obesity, cardiovascular disease, hypertension, and type 2 diabetes (Bueno-Antequera & Munguía-Izquierdo, 2023; Papry et al., 2024; Park et al., 2020). The World Health Organization (WHO) has repeatedly highlighted the dangers associated with inactivity, and there is growing concern about the long-term consequences of sedentary behaviour on individual health and well-being (World Health Organization, 2024). Identifying exercise strategies that can effectively counteract the adverse effects of sedentarism is paramount for improving public health outcomes (Calcaterra et al., 2023; Faghy et al., 2024).

Body composition, which refers to the proportions of fat mass, lean muscle mass, and other components of the body, plays a crucial role in determining an individual's overall health (Lu et al., 2024; Olshvang et al., 2024; Petřeková et al., 2024). A healthy body composition, characterized by lower fat mass and higher lean mass, has been associated with reduced risk factors for metabolic disorders, improved physical functioning, and enhanced quality of life (Benton & Hutchins, 2024; Chianeh et al., 2024; Lestari et al., 2024). In contrast, excess fat mass, particularly visceral fat, is linked to many health problems, including insulin resistance, inflammation, and a higher likelihood of developing cardiovascular disease (Bosello et al., 2024; Hagberg & Spalding, 2024). For individuals leading a sedentary lifestyle, one of the primary goals of exercise interventions is to shift body composition toward a healthier balance by reducing fat mass and increasing lean muscle mass.

Resistance training has emerged as one of the most effective modalities for altering body composition (Bellicha et al., 2021; X. Chen et al., 2024; Rejeki et al., 2023). In challenging the muscles to work against resistance, this exercise promotes muscle hypertrophy, increases metabolic rate, and contributes to fat loss (Kataoka et al., 2024; Mambrini et al., 2024). Resistance training builds muscular strength, enhances muscle endurance, and promotes long-term weight management (Abou Sawan et al., 2023; Cox, 2024). Various forms of resistance training are available, with kettlebell and bodyweight resistance training being two prominent methods that have gained attention in recent years due to their effectiveness and accessibility.

Kettlebell training, which utilizes a uniquely shaped weight resembling a cannonball with a handle, has grown in popularity due to its multifunctional nature. Kettlebell exercises often involve compound movements that engage multiple muscle groups simultaneously, such as kettlebell swings, snatches, and Turkish get-ups. These dynamic movements improve strength and increase cardiovascular endurance, making kettlebell training a time-efficient option for improving body composition and overall fitness (Meigh et al., 2022). Importantly, the swinging and ballistic motions involved in kettlebell training stimulate core stabilization and full-body coordination, providing functional fitness benefits that translate to daily activities. Studies suggest that kettlebell workouts can significantly improve muscular strength, endurance, and aerobic capacity while also contributing to fat loss and lean muscle gain (H.-T. Chen et al., 2018; Govindasamy et al., 2024; Radhika & Shanmugavalli, 2024). Bodyweight resistance training, on the other hand, has a long history of being a fundamental part of physical fitness routines across various disciplines (Sevilmis et al., 2023). This form of training involves using one's body weight to provide resistance against gravity, incorporating exercises such as push-ups, squats, lunges, and planks (Ernandini & Giovanni Mulyanaga, 2023; Palmer & McCabe, 2023). Bodyweight training requires no equipment and can be performed in virtually any setting, making it one of the most accessible forms of exercise for people at all fitness levels (Spotswood et al., 2023; Wackerhage & Schoenfeld, 2021). For individuals, bodyweight resistance training offers a non-intimidating entry point into physical activity. Research has shown that bodyweight training can be efficient for building muscular strength, enhancing muscular endurance, and improving flexibility, all of which are critical components of physical fitness (Fayazmilani et al., 2022; Koźlenia et al., 2024; Nasrulloh et al., 2022). Moreover, bodyweight training has been associated with improved metabolic health, making it a valuable tool for those seeking to improve body composition through fat loss and muscle gain (Carneiro et al., 2018).

While kettlebell and bodyweight resistance training are effective methods for improving body composition, there must be a more direct comparison between these modalities, especially in young adults populations. Therefore, this study aims to fill this gap by evaluating the effects of kettlebell training versus bodyweight resistance training on body composition in young adults.

Methods

Participants

The analysis revealed that 18 participants were required to identify a significant medium effect with an alpha error probability of 0.05 and a power of 0.80 for the interaction between factors. Figure 1 presents a graphical representation of the study design. Initially, 24 college-age male students consented to participate in the study. Eligibility criteria for the study included: (i) no history of lower limb injuries in the six months preceding the study, (ii) participation in strength training programs for at least three months prior to the study, and (iii) achieving a minimum threshold in the one-repetition maximum (1-RM) test for a major resistance exercise (e.g., squat or bench press) to ensure safe participation in the study's training programs. The top 18 participants who met the 1-RM criteria were selected for inclusion. The assessment of maximal strength was based on the 1-RM test, a commonly used measure in resistance training studies to evaluate muscular strength (Brzycki, 1993). Six participants who did not complete the assessment were excluded. The study comprised 18 participants, categorized into three groups: Body Weight Resistance Training Group (BWRTG, n=6), Kettlebell Resistance Training Group (KRTG, n=6), and a Passive Control Group (CG, n=6). Additionally, throughout the trial period, there were no severe injuries related to testing or training, and both the KRTG and body weight BWRTG demonstrated perfect attendance rates of 100%. All groups of participants shared comparable demographic characteristics, as detailed in Table 1. Before the study commenced, participants were briefed about the potential risks and benefits associated with the research. Subsequently, informed consent was obtained from each participant. The research obtained approval from the local ethics committee (SBU/RHS/SBUEC/20/067/2023) and complied with the ethical standards outlined in the Declaration of Helsinki (1964, revised 2013).

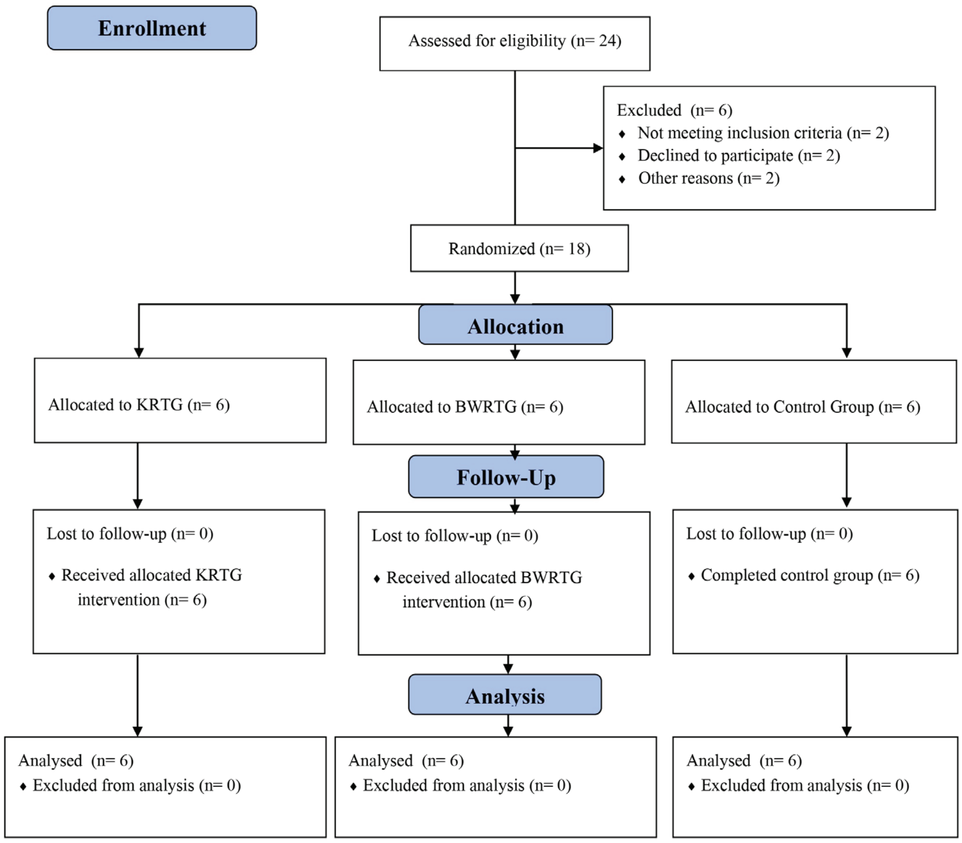

FIGURE 1. CONSORT Flow Chart

Procedure

One week prior to the baseline assessment, participants underwent two familiarization sessions to become familiar with the body composition tests. During these sessions, demographic information was also collected. Participants were instructed to avoid intense physical activity and alcohol consumption for 24 hours before the testing. A randomized longitudinal design was employed to evaluate the effects of the exercise interventions, specifically Kettlebell Resistance Training (KRT) and Body Weight Resistance Training (BWRT) on BM – body mass, SM – skeletal mass, BF- body fat mass, BMI- body mass index, BFP- body fat percentage, WHO- wait hip ratio, VFA-visceral fat area. Measurements were taken after participants completed a 10-minute general warm-up. Evaluations were conducted during the early morning hours, between 7:30 a.m. and 9:30 a.m., at biomedcal lab, under stable room conditions (temperature ranging from (around 20°C to 24°C) and humidity (40-60%)).

Outcome Measures

Body Composition

Body composition was measured using multifrequency bioelectrical impedance analysis with the InBody 720 device (Biospace Co. Ltd., Seoul, Korea). The assessments took place in the morning between 7 a.m. and 8 a.m. Participants were instructed to wear light, standard indoor attire (such as shorts and a T-shirt) to minimize the influence of clothing weight on the measurements. Additionally, all participants were instructed to remove any metallic objects, including rings, watches, bracelets, and other jewelry, to avoid interference with the electrical currents used in the BIA test. This step ensures more accurate body composition readings. They stood barefoot on the platform with their feet placed on the foot electrodes. While maintaining an upright posture, participants abducted their arms slightly from the body and held onto the hand electrodes positioned on the device's handles, holding this position throughout the test for consistent and reliable measurements (Lee & Gallagher, 2008).

Interventions

The training intervention for the KRTG and the BWRTG was designed to be progressive and structured over a 12-week period in Table 1 (Govindasamy et al., 2024). For both groups, participants were instructed to rest for 60-90 seconds between sets, allowing sufficient recovery while maintaining an appropriate intensity level throughout the training sessions. Each group performed their training three times per week, with KRTG sessions scheduled for Monday, Wednesday, and Friday, while BWRTG sessions occurred on Tuesday, Thursday, and Saturday. Each session began with a 10-minute warm-up that included dynamic stretches and mobility exercises to prepare participants for the workout.

For the KRTG, the program was divided into three phases. In the first four weeks, participants completed 2 sets of 10-12 repetitions of exercises such as kettlebell swings, goblet squats, kettlebell deadlifts, kettlebell presses (overhead press), kettlebell lunges, and kettlebell rows, using light to moderate kettlebell weights (20-40% of their one-repetition maximum, or 1RM). The second phase, weeks 5-8, increased the workload to 3 sets of 8-10 repetitions with moderate kettlebell weights (40-60% of 1RM). In the final phase, weeks 9-12, participants performed 4 sets of 6-8 repetitions with challenging weights (60-80% of 1RM), followed by a 10-minute cool-down of static stretches.

The BWRTG followed a similar structure, focusing on bodyweight exercise intensity. Participants began with 2 sets of 10-12 repetitions for the first four weeks, incorporating exercises such as push-ups, squats, lunges, planks, burpees, and mountain climbers at a moderate pace. From weeks 5-8, the program progressed to 3 sets of 8-10 repetitions, increasing the speed and complexity of the movements. In the final weeks, participants completed 4 sets of 6-8 repetitions, incorporating advanced variations, including plyometric exercises, and concluded each session with a 10-minute static stretch cool-down.

Table 1. Training schedule for the KRT group and BWRT group

Week	KRTG	BWRTG
1-4	2 sets of 10-12 reps	2 sets of 10-12 reps
5-8	3 sets of 8-10 reps	3 sets of 8-10 reps
9-12	4 sets of 6-8 reps	4 sets of 6-8 reps

Statistical Analysis

The descriptive statistics for the participants are summarized as mean and standard deviation, calculated utilizing IBM SPSS Statistics version 29.0 (SPSS Inc., Chicago, IL, USA). To assess normality, the Shapiro-Wilk test was employed (Shapiro & Wilk, 1965), Levene's test was employed to assess the homogeneity of variance. The normality of the outcomes was assessed for each group individually, with all results showing p-values greater than 0.05, indicating normal distribution. Homogeneity of variances was evaluated using Levene's test, which also resulted in p-values exceeding 0.05. To analyze baseline data across three groups, one-way ANOVA was conducted (Fisher, 1992), followed by Bonferroni's post hoc tests for pairwise comparisons. A mixed model ANOVA was employed to assess the intervention's effect on body composition outcomes, combining group components (CG, KRTG, BWRTG) and time points (baseline and post-intervention) (Verbeke, 1997). Interaction effects were documented with p-values and partial eta squared (η^2p). Effect sizes were classified as follows: η^2p of 0.01 indicates a small effect, 0.06 denotes a medium effect, and 0.14 represents a large effect (Cohen, 1988). A simple effects test was conducted following the confirmation of the interaction between group and time to ensure accurate analysis. The magnitude of differences between means was assessed using Cohen's d (effect size, ES) (Cohen, 1988), calculated with the formula (mean post-intervention – mean pre-intervention) / pooled standard deviation. Cohen's d values of 0.20, 0.50, and 0.80 are interpreted as representing small, moderate, and large effects, respectively (Cohen, 1988). Statistical significance was assessed using a threshold of $p<0.05$.

Results

Eighteen adults, completed the baseline assessments for the study. Table 2 displays the baseline characteristics of the participants.

Table 2. Participant Demographics in the Experimental Groups (KRTG, BWRTG) and Control Group

Group	KRTG	BWRT	CG	P value
Age	20.62 ± 2.15	20.46 ± 1.74	20.21 ± 2.57	0.542
Height	169.7 ± 4.8	168.1 ± 6.2	169.5 ± 2.4	0.527
Weight	64.5 ± 6.2	62.1 ± 5.4	53.3 ± 7.6	0.634

Note. CG – control group, KRTG – kettlebell resistance training group, BWRTG – body weight resistance training group

Significant differences were observed between the two groups: KRTG and the Control Group (CG) in terms of BM and BMI ($p<0.05$). No other significant differences were found between the groups prior to the exercise intervention ($p>0.05$). Descriptive statistics for body composition before and after the intervention are provided in Table 3. A significant main effect of the group on BM was observed, with a p-value of 0.025 and a partial eta squared (η^2p) of 0.41, as well as on BMI with a p-value of 0.024 and η^2p of 0.35. However, no significant group differences were observed for SM , BF, BFP, VFA, or WHR. A significant main effect of time was found for BF ($p=0.003$, $\eta^2p=0.44$), BFP ($p=0.007$, $\eta^2p=0.40$), and VFA ($p<0.001$, $\eta^2p=0.46$). However, there were no significant changes over time in BM, SM, BMI, and WHR. There was a significant interaction effect between group and time for the WHR ($p=0.036$, $\eta^2p=0.36$). Additionally, a trend toward a significant interaction effect was observed for VFA ($p=0.054$, $\eta^2p=0.37$), although this result did not reach statistical significance. Subsequent analysis indicated no notable differences in WHR between the groups at baseline or following the intervention. Pairwise comparisons within the groups indicated a significant reduction in WHR in the KRTG group ($p=0.036$, effect size=0.52). In contrast, no significant changes were noted in the BWRTG group ($p=0.176$, effect size=0.24) or the control group ($p=0.160$, effect size=0.27). Figure 2 illustrates the variations in body composition both within and between groups. Within-group analyses revealed a significant reduction in BF for the KRTG ($p=0.032$, ES=0.22, small effect) and BWRTG ($p=0.021$, ES=0.29, small effect) groups. In contrast, no significant changes were observed in the CG for BF ($p=0.657$, ES = 0.06, very small effect). Similarly, significant decreases in BFP were noted in the KRTG ($p=0.040$, ES=0.22, small effect) and BWRTG ($p=0.037$, ES=0.21, small effect) groups. However, no significant changes in BFP were found in the CG ($p=0.499$, ES=0.08, very small effect). A significant reduction in VFA was observed in the KRTG ($p=0.004$, ES=0.36, moderate effect) and BWRTG ($p=0.002$, ES=0.60, large effect) groups. No significant changes in VFA were noted in the CG ($p=0.672$, ES=0.06, very small effect). Between-group comparisons showed significant differences in body mass and body mass index post-intervention. Specifically, BM was significantly different between KRTG and CG ($p=0.024$, ES=1.56, large effect), and BMI was significantly different between KRTG and CG (p=0.029, ES=1.67, large effect). It is essential to recognize that there were also significant baseline differences between KRTG and CG in BM (p=0.034, ES=1.69, large effect) and in BMI (p=0.022, ES=1.71, large effect), which may limit the interpretation of these significant post-intervention differences.

Table 3. Pre & Post-test performances of body composition varaibles in young adults following 12 weeks of three groups:KRTG, BWRTG & CG

Outcome Measures	Groups	Mean ± SD		% Change	Main effect group		Main effect time		Interaction group × time	
		Pre Test (before)	Post Test (after)		p	η^2p	p	η^2p	p	η^2p
BM (kg)	CG	53.3 ± 7.6	53.6 ± 6.4	0.56	0.025*	0.41	0.214	0.12	0.541	0.07
	KRTG	64.5 ± 6.2	63.5 ± 3.7	-1.55						
	BWRTG	62.1 ± 5.4	61.3 ± 6.4	-1.28						
SM (kg)	CG	22.4 ± 3.5	22.6 ± 3.7	0.89	0.208	0.21	0.067	0.20	0.620	0.09
	KRTG	25.1 ± 2.3	26.5 ± 3.4	5.57						
	BWRTG	23.2 ± 4.2	23.8 ± 5.1	2.58						
BF (kg)	CG	14.5 ± 4.3	14.2 ± 5.1	-2.06	0.424	0.13	0.003**	0.44	0.341	0.18
	KRTG	17.6 ± 5.1	16.5 ± 4.5	-6.25						
	BWRTG	16.4 ± 3.4	15.3 ± 4.1	-6.70						
BMI (kg/m^2)	CG	21.2 ± 1.4	21.2 ± 1.4	0	0.024*	0.35	0.167	0.19	0.515	0.08
	KRTG	23.4 ± 1.2	23.3 ± 1.2	-0.42						
	BWRTG	22.3 ± 1.5	22.0 ± 1.4	-1.34						
BFP (%)	CG	26.1 ± 7.3	25.5 ± 6.9	-2.29	0.845	0.03	0.007**	0.40	0.541	0.12
	KRTG	27.6 ± 7.6	26.4 ± 1.2	-4.34						
	BWRTG	26.7 ± 6.6	25.4 ± 5.7	-4.86						
WHR	CG	0.83 ± 0.4	0.84 ± 0.4	1.20	0.863	0.04	0.186	0.13	0.036*	0.36
	KRTG	0.85 ± 0.3	0.84 ± 0.3	-1.17						
	BWRTG	0.84 ± 0.4	0.83 ± 0.4	-1.19						
VFA	CG	56.3 ± 27.1	54.6 ± 26.3	-3.01	0.768	0.10	< .001**	0.46	0.054	0.37
	KRTG	75.5 ± 26.3	66.3 ± 24.2	-12.18						
	BWRTG	68.6 ± 19.4	58.3 ± 14.6	-15.01						

*p<0.05; **p<0.01; Abbreviations: CG – control group, KRTG – kettlebell resistance training group, BWRTG – body weight resistance training group, BM – body mass, SM – skeletal mass, BF- body fat mass, BMI- body mass index, BFP- body fat percentage, WHO- wait hip ratio, VFA-visceral fat area.

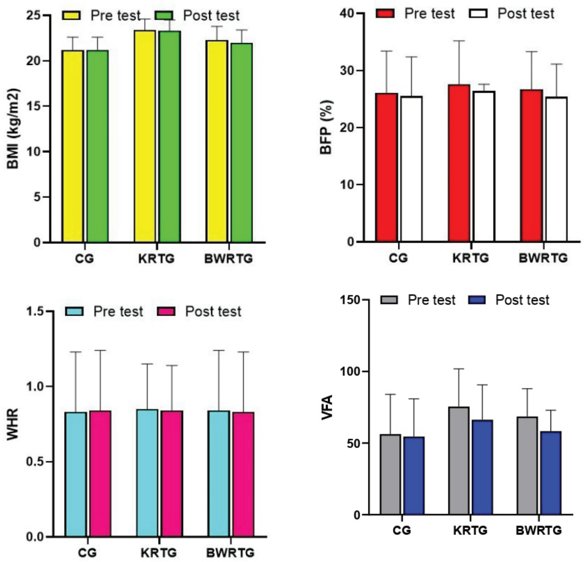

FIGURE 2. Graphical depiction of the percentage change in outcome variables from pre- to post-intervention for each group. BMI- body mass index, BFP- body fat percentage, WHR- wait hip ratio, VFA-visceral fat area.

Discussion

The results of this study provide a comprehensive comparison of the effects of KRTG and BWRTG on body composition among young adult males. KRTG and BWRTG significantly improved key body composition measures, particularly in reducing BFP, BF, and VFA. These findings are consistent with previous studies that support the efficacy of resistance training in fat loss and overall health improvement (Govindasamy et al., 2024; Radhika & Shanmugavalli, 2024). However, KRTG had an even further benefit in decreasing the WHR, indicating that kettlebell exercises' ballistic and compound nature might provide a particular advantage for core stabilization and fat partitioning. These findings offer vital information for elaborating training plans for modifying BM, SM, and other body composition variables, particularly among young adults individuals.

The nature of the two training modalities can account for some of the mechanisms behind the results. Body fat mass, body fat rate, and visceral fat area were decreased in the KRTG and BWRT groups compared with model control groups. The combination of significant muscle mass involvement in a progressive manner and higher energy demands probably caused this. KRTG also showed a particular boon to the WHR through its dynamic and complex actions, unlike static machine-based cross-sectional techniques used in PBL (e.g., kettlebell swings and Turkish getups). These workouts have more impact on core stabilization, making a more significant difference in reducing belly fat and improving fat distribution. The engagement of large muscle groups in KRT might have provided a more significant stimulus for central fat loss, reflected in the superior outcomes in WHR for this group. On the other hand, both training modalities were equally effective in reducing body fat and visceral fat due to the combination of aerobic and resistance training benefits, promoting overall fat loss and muscle hypertrophy.

The young adults group had considerably greater values in variables linked to body fat, particularly in BFP, fat mass, and fat mass index, as compared to the active group (Mateo-Orcajada et al., 2022). Within the scope of this study, a comparison was made between the effects of 12 weeks of BWRT, and KRT on body composition as measured by BM, SM, BF, BMI, BFP, WHR, and VFA in young adults. Some of the research that have previously proven that KRTG has a considerable impact on body composition in various populations. KTRG was found to have a substantial effect on body composition when compared to aerobic exercise on obese male adults (Govindasamy et al., 2022). Similarly, compared to the control group, the research found that volleyball players who undergo with kettlebells and battle ropes saw significant improvements in their body composition (Radhika & Shanmugavalli, 2024). Whereas, BWRT found to have a substantial effect on body composition (Fayazmilani et al., 2022). Several cardiovascular disorders are linked to body composition, particularly fat mass index (Larsson et al., 2020). Prior to the training intervention, the young adults in the current study had BM mean ranges of 53.3 to 64.5 kg, SM of 22.4 to 25.1 kg, BF of 14.5 to 17.6 kg, and BMI of 21.2 to 23.4 kg/m2. Additionally, their BFP ranged from 26.1 to 27.6%, WHR ranged from 0.83 to 0.85m/m, and VFA ranged from 56.3 to 75.5 cm2. All of these values were within the range previously noted in previous research on sedentary adolescents (Sun et al., 2024). In this current study, before and after the 12 weeks of KRT and BWRT the results showed a significant reduction in BF, BFP and VFA for the KRTG and BWRTGs, while no significant changes were observed in the CG. Previous research has also indicated that BWRTG and KRTG are effective in lowering the BFP in obese persons over the course of a 12-week intervention period (Govindasamy et al., 2024). One of the most frequent ways to reduce BFP is through resistance exercise (Poutafkand et al., 2020). Due to the fact that resistance training is not particularly strenuous, the body relies mostly on the aerobic oxidation of sugar and fat as its primary source of energy. This process can be rather intense in order to accomplish the goal of fat reduction (Astorino, 2000; Stisen et al., 2006). Previous research indicates that a resistance training program that does not include the use of any apparatuses and instead makes use of the participant's own body weight as a load appears to be successful in lowering visceral fat and improving metabolic profiles at the same time (Tsuzuku et al., 2007). It has been demonstrated through a systematic review and meta-analysis that resistance training is effective in lowering visceral fat, body fat mass, and BFP in individuals who are in good health (Wewege et al., 2022).

A number of other body composition measurements, including BM, SM, BMI, and WHR, did not exhibit any indication of a significant variation between the pre- and post-assessment periods. Some of the results of the systematic review and meta-analysis are consistent with the findings of the current investigation, which demonstrated that the impact of resistance training on the participant's BMI values was not significant (Liu et al., 2022; Schranz et al., 2013). Similarly, following a period of six weeks of KRTG, there were no discernible changes in BM in healthy 19–26 years age men (Otto et al., 2012) and recreationally active participants (Erbes & Hoar, 2012). KRTG in normal people for 8 weeks showed no significant changes in body composition, including skeletal muscle mass and BMI, according to measurement points (Pre, mid and post) (Jeong et al., 2017). Breukelman et al. (2013) examines the effects on WHR of inactive individuals aged 20-65 years which receive 12 weeks of home-based exercise consisting of aerobic, resistance, and stretching. Following the training procedures, no discernible change was seen WHR (Breukelman et al., 2013). According to the current study, short-term exercise regimens did not have an appreciable improvement in BM, SM, BMI, WHR. The lack of expertise the individuals had with weightlifting and kettlebell activities may have promoted nervous system adaptations more than muscle growth because of their limited resistance training experience. Therefore, brain changes are probably the main mechanism resulting in enhanced performance (Otto et al., 2012). The study by Andersen et al. (2016) show that resistance training for a period of 52 weeks results in substantial improvements in body composition assessments (Andersen et al., 2016).

When we considering the group effect the post-intervention had significant differences in BM and BMI between the KRTG and CG groups. These differences were also observed in baseline BM and BMI between the two groups. However, there are no appreciable variations in any of the body composition metrics between the two intervention groups. Previous studies in line with the current study result, demonstrated no discernible variations in body composition parameters between KRTG and BWRTG (Govindasamy et al., 2024). WHR and BMI are helpful quantifiable indicators for determining overweight and obesity.

The current study has shown that similar outcomes between these two groups suggest that both methods can effectively reduce BMI and improve overall body composition. KRTG was beneficial for central fat distribution regarding WHR improvement, which could be an interesting perspective for many seeking to normalize their central body fat mass. These results indicate that integrating both training approaches could be advantageous for enhancing health outcomes in young adult males.

Limitations

The study has few limitations. This restricted sample size makes it harder to extrapolate the results to a larger population. The objective of next studies ought to encompass a more extensive and heterogeneous cohort to augment the resilience and relevance of the findings. Furthermore, some confounding variables were not controlled, including the participants' nutrition, their level of physical activity outside of the intervention, and lifestyle characteristics. This might have affected the results and made it more difficult to determine the actual benefits of the resistance training interventions. This study may not have given a complete picture of the impact of the training treatments because it only looked at body composition as the dependent variable. The fact that the control group (CG) and the KRTG had notable baseline variations in BM and BMI poses a limitation to this study. These pre-intervention variations might have an impact on how the post-intervention outcomes are interpreted since the changes that are shown may have been impacted by the groups' original circumstances in addition to the intervention itself. To increase the validity of the results, future research should concentrate on employing better randomisation or stratification to provide more balanced baseline circumstances.

Conclusion

In conclusion, both the twelve-week KRTG and BWRTG programs demonstrated similarly effective results in reducing body fat mass, fat percentage, and visceral fat area in young males. These findings highlight that both training approaches are viable options for improving body composition, with kettlebell training offering the added advantage of positively impacting waist-to-hip ratio. For those looking to optimize fat reduction and overall body composition, incorporating either training regimen can be beneficial.

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Conflicts of interest
The authors declare that there are no conflict of interest.

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References

Abou Sawan, S., Nunes, E. A., Lim, C., McKendry, J., & Phillips, S. M. (2023). The Health Benefits of Resistance Exercise: Beyond Hypertrophy and Big Weights. *Exercise, Sport and Movement*, *1*(1). https://doi.org/10.1249/ESM.0000000000000001

Andersen, T. R., Schmidt, J. F., Pedersen, M. T., Krustrup, P., & Bangsbo, J. (2016). The Effects of 52 Weeks of Soccer or Resistance Training on Body Composition and Muscle Function in +65-Year-Old Healthy Males – A Randomized Controlled Trial. *PLoS One*, *11*(2), e0148236. https://doi.org/10.1371/journal.pone.0148236

Astorino, T. A. (2000). Is the ventilatory threshold coincident with maximal fat oxidation during submaximal exercise in women? *The Journal of Sports Medicine and Physical Fitness*, *40*(3), 209–216.

Bellicha, A., Van Baak, M. A., Battista, F., Beaulieu, K., Blundell, J. E., Busetto, L., . . . & Oppert, J. (2021). Effect of exercise training on weight loss, body composition changes, and weight maintenance in adults with overweight or obesity: An overview of 12 systematic reviews and 149 studies. *Obesity Reviews*, *22*(S4), e13256. https://doi.org/10.1111/obr.13256

Benton, M. J., & Hutchins, A. M. (2024). The relationship between resting metabolic rate and quality of life is moderated by age and body composition in women: A cross-sectional study. *BMC Women's Health*, *24*(1), 235. https://doi.org/10.1186/s12905-024-03085-0

Bosello, F., Vanzo, A., Zaffalon, C., Polinelli, L., Saggin, F., Bonacci, E., . . . & Bosello, O. (2024). Obesity, body fat distribution and eye diseases. *Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity*, *29*(1), 33. https://doi.org/10.1007/s40519-024-01662-8

Breukelman, G. J., Semple, S. J., & Grace, J. M. (2013). The effect of a 12-week home-based exercise intervention program on cardiometabolic disease risk factors. *Gazzetta Medica Italiana Archivio per Le Scienze Mediche*, *172*(4), 275–282.

Brzycki, M. (1993). Strength Testing—Predicting a One-Rep Max from Reps-to-Fatigue. *Journal of Physical Education, Recreation & Dance*, *64*(1), 88–90. https://doi.org/10.1080/07303084.1993.10606684

Budreviciute, A., Damiati, S., Sabir, D. K., Onder, K., Schuller-Goetzburg, P., Plakys, G., . . . & Kodzius, R. (2020). Management and Prevention Strategies for Non-communicable Diseases (NCDs) and Their Risk Factors. *Frontiers in Public Health*, *8*, 574111. https://doi.org/10.3389/fpubh.2020.574111

Bueno-Antequera, J., & Munguía-Izquierdo, D. (2023). Physical Inactivity, Sedentarism, and Low Fitness: A Worldwide Pandemic for Public Health. In N. Rezaei (Ed.), *Integrated Science of Global Epidemics* (Vol. 14, pp. 429–447). Springer International Publishing. https://doi.org/10.1007/978-3-031-17778-1_19

Calcaterra, V., Vandoni, M., Marin, L., Carnevale Pellino, V., Rossi, V., Gatti, A., . . . & Zuccotti, G. (2023). Exergames to Limit Weight Gain and to Fight Sedentarism in Children and Adolescents with Obesity. *Children*, *10*(6), 928. https://doi.org/10.3390/children10060928

Carneiro, M. A. S., De Oliveira, A. A., Martins, F. M., Souza, A. P., Nunes, P. R. P., & Orsatti, F. L. (2018). High-intensity interval body weight training promotes different adaptations to combined training in body composition and muscle strength in young women. *Science & Sports*, *33*(3), e105–e113. https://doi.org/10.1016/j.scispo.2017.11.001

Chen, H.-T., Wu, H.-J., Chen, Y.-J., Ho, S.-Y., & Chung, Y.-C. (2018). Effects of 8-week kettlebell training on body composition, muscle strength, pulmonary function, and chronic low-grade inflammation in elderly women with sarcopenia. *Experimental Gerontology*, *112*, 112–118. https://doi.org/10.1016/j.exger.2018.09.015

Chen, X., He, H., Xie, K., Zhang, L., & Cao, C. (2024). Effects of various exercise types on visceral adipose tissue in individuals with overweight and obesity: A systematic review and network meta-analysis of 84 randomized controlled trials. *Obesity Reviews*, *25*(3), e13666. https://doi.org/10.1111/obr.13666

Chianeh, Y. R., Mehrabani, A. M., Kharazi, A. A., Ghaffari, M., & Asgari, F. (2024). Role of Nutritional Factors, Mitochondrial Dysfunction, Altered Body Composition and Various Biological Factors in Chronic Fatigue Syndrome. *Journal of Advances in Medical and Pharmaceutical Sciences*, *26*(6), 23–36. https://doi.org/10.9734/jamps/2024/v26i6692

Cohen, D. (1988). *Statistical power analysis for the behaviors science* (2nd ed.).

Cox, A. (2024). How Can Muscle-Strengthening Activities Be Promoted in School Settings? In A. García-Hermoso (Ed.), *Promotion of Physical Activity and Health in the School Setting* (pp. 327–357). Springer Nature, Switzerland. https://doi.org/10.1007/978-3-031-65595-1_15

El-Kotob, R., Ponzano, M., Chaput, J.-P., Janssen, I., Kho, M. E., Poitras, V. J., . . . & Giangregorio, L. M. (2020). Resistance training and health in adults: An overview of systematic reviews. *Applied Physiology, Nutrition, and Metabolism*, *45*(10 (Suppl. 2)), S165–S179. https://doi.org/10.1139/apnm-2020-0245

Erbes, D. A., & Hoar, R. H. (2012). *The Effect of Kettlebell Training on Body Composition, Flexibility, Balance, and Core Strength*.

Ernandini, E., & Giovanni Mulyanaga, W. (2023). Resistance Training is Medicine: Stay Active and Reap the Reward, Live in your Life! In Bridging Science and Practical Appliance in Resistance Training. *IntechOpen*. https://doi.org/10.5772/intechopen.109973

Faghy, M. A., Tatler, A., Chidley, C., Fryer, S., Stoner, L., Laddu, D., . . . & Ashton,

R. E. (2024). The physiologic benefits of optimizing cardiorespiratory fitness and physical activity – From the cell to systems level in a post-pandemic world. *Progress in Cardiovascular Diseases*, *83*, 49–54. https://doi.org/10.1016/j.pcad.2024.02.006

Fayazmilani, R., Abbasi, A., Hovanloo, F., & Rostami, S. (2022). The effect of TRX and bodyweight training on physical fitness and body composition in prepubescent soccer athletes. *Sport Sciences for Health*, *18*(4), 1369–1377. https://doi.org/10.1007/s11332-022-00908-1

Fisher, R. A. (1992). Statistical Methods for Research Workers. In S. Kotz & N. L. Johnson (Eds.), *Breakthroughs in Statistics* (pp. 66–70). Springer New York. https://doi.org/10.1007/978-1-4612-4380-9_6

Fletcher, G. F., Landolfo, C., Niebauer, J., Ozemek, C., Arena, R., & Lavie, C. J. (2018). Promoting Physical Activity and Exercise. *Journal of the American College of Cardiology*, *72*(14), 1622–1639. https://doi.org/10.1016/j.jacc.2018.08.2141

Govindasamy, K., Gogoi, H., Jebabli, N., Bediri, S. M., Aljahni, M., Parpa, K., . . . & Zouhal, H. (2024). The effects of kettlebell training versus resistance training using the own body mass on physical fitness and physiological adaptations in obese adults: A randomized controlled trial. *BMC Sports Science, Medicine and Rehabilitation*, *16*(1), 106. https://doi.org/10.1186/s13102-024-00894-6

Govindasamy, K., Suresh, C., Saran, K. S., Anand, M., Kaur, D., Anitha, J. B., . . . & Achouri, I. (2022). Role of aerobics exercise and kettlebell training improving on selected health related physical fitness parameters in obese male adults. *Health, Sport, Rehabilitation*, *8*(4), 8–19. https://doi.org/10.34142/HSR.2022.08.04.01

Hagberg, C. E., & Spalding, K. L. (2024). White adipocyte dysfunction and obesity-associated pathologies in humans. *Nature Reviews Molecular Cell Biology*, *25*(4), 270–289. https://doi.org/10.1038/s41580-023-00680-1

Jeong, H.-J., Kim, Y.-S., Cho, W.-S., Kim, W.-G., Kim, Y.-B., & Kim, Y.-N. (2017). Effect of Kettle Bell Swing Exercise on the Body Composition and Lower Limb Muscular Activity. *The Journal of Korean Physical Therapy*, *29*(4), 194–200. https://doi.org/10.18857/jkpt.2017.29.4.194

Kataoka, R., Hammert, W. B., Yamada, Y., Song, J. S., Seffrin, A., Kang, A., . . . & Loenneke, J. P. (2024). The Plateau in Muscle Growth with Resistance Training: An Exploration of Possible Mechanisms. *Sports Medicine*, *54*(1), 31–48. https://doi.org/10.1007/s40279-023-01932-y

Koźlenia, D., Popowczak, M., Szafraniec, R., Alvarez, C., & Domaradzki, J. (2024). Changes in Muscle Mass and Strength in Adolescents Following High-Intensity Functional Training with Bodyweight Resistance Exercises in Physical Education Lessons. *Journal of Clinical Medicine*, *13*(12), 3400. https://doi.org/10.3390/jcm13123400

Larsson, S. C., Bäck, M., Rees, J. M. B., Mason, A. M., & Burgess, S. (2020). Body mass index and body composition in relation to 14 cardiovascular conditions in UK Biobank: A Mendelian randomization study. *European Heart Journal*, *41*(2), 221–226. https://doi.org/10.1093/eurheartj/ehz388

Lee, S. Y., & Gallagher, D. (2008). Assessment methods in human body composition. *Current Opinion in Clinical Nutrition & Metabolic Care*, *11*(5), 566–572. https://doi.org/10.1097/MCO.0b013e32830b5f23

Lestari, N. N. W., Kusumawardani, I. A. J. D., Harimawan, A. I. W., Candrawati, N. W., Artana, I. G. N. B., Arisanti, N. L. P. E., & Rai, I. B. N. (2024). Relationship Between Neutrophil-To-Lymphocyte Ratio, Muscle Mass and Fat Mass Percentage with Quality of Life in Non-Small Cell Lung Cancer. *International Journal Of Scientific Advances*, *5*(2). https://doi.org/10.51542/ijscia.v5i2.21

Liang, Z., Zhang, M., Wang, C., Yuan, Y., & Liang, J. (2022). Association between sedentary behavior, physical activity, and cardiovascular disease-related outcomes in adults—A meta-analysis and systematic review. *Frontiers in Public Health*, *10*, 1018460. https://doi.org/10.3389/fpubh.2022.1018460

Liu, X., Gao, Y., Lu, J., Ma, Q., Shi, Y., Liu, J., Xin, S., & Su, H. (2022). Effects of Different Resistance Exercise Forms on Body Composition and Muscle Strength in Overweight and/or Obese Individuals: A Systematic Review and Meta-Analysis. *Frontiers in Physiology*, *12*, 791999. https://doi.org/10.3389/fphys.2021.791999

Lu, Z., Hu, Y., Chen, X., Ou, Q., Liu, Y., Xu, T., . . . & Shan, G. (2024). Sex-specific associations between total and regional Fat-to-muscle Mass ratio and cardiometabolic risk: Findings from the China National Health Survey. *Nutrition Journal*, *23*(1), 104. https://doi.org/10.1186/s12937-024-01007-2

Mambrini, S. P., Grillo, A., Colosimo, S., Zarpellon, F., Pozzi, G., Furlan, D., . . . & Bertoli, S. (2024). Diet and physical exercise as key players to tackle MASLD through improvement of insulin resistance and metabolic flexibility. *Frontiers in Nutrition*, *11*, 1426551. https://doi.org/10.3389/fnut.2024.1426551

Mateo-Orcajada, A., González-Gálvez, N., Abenza-Cano, L., & Vaquero-Cristóbal, R. (2022). Differences in Physical Fitness and Body Composition Between Active and Sedentary Adolescents: A Systematic Review and Meta-Analysis. *Journal of Youth and Adolescence*, *51*(2), 177–192. https://doi.org/10.1007/s10964-021-01552-7

Meigh, N. J., Keogh, J. W. L., Schram, B., Hing, W., & Rathbone, E. N. (2022). Effects of supervised high-intensity hardstyle kettlebell training on grip strength and health-related physical fitness in insufficiently active older adults: The BELL pragmatic controlled trial. *BMC Geriatrics*, *22*(1), 354. https://doi.org/10.1186/s12877-022-02958-z

Moholdt, T., Lavie, C. J., & Nauman, J. (2017). Interaction of Physical Activity and Body Mass Index on Mortality in Coronary Heart Disease: Data from the Nord-Trøndelag Health Study. *The American Journal of Medicine*, *130*(8), 949–957. https://doi.org/10.1016/j.amjmed.2017.01.043

Moro, T., Marcolin, G., Bianco, A., Bolzetta, F., Berton, L., Sergi, G., & Paoli, A. (2020). Effects of 6 Weeks of Traditional Resistance Training or High Intensity Interval Resistance Training on Body Composition, Aerobic Power and Strength in Healthy Young Subjects: A Randomized Parallel Trial. *International Journal of Environmental Research and Public Health*, *17*(11), 4093. https://doi.org/10.3390/ijerph17114093

Nasrulloh, A., Apriyanto, K. D., Yuniana, R., Dev, R. D. O., & Yudhistira, D. (2022). Developing Self Body Weight Training Methods to Improve Physical Fitness in the COVID-19 Era: Aiken Validity. *Journal of Hunan University Natural Sciences*, *49*(6), 129–139. https://doi.org/10.55463/issn.1674-2974.49.6.14

Olshvang, D., Harris, C., Chellappa, R., & Santhanam, P. (2024). Predictive modeling of lean body mass, appendicular lean mass, and appendicular skeletal muscle mass using machine learning techniques: A comprehensive analysis utilizing NHANES data and the Look AHEAD study. *PLoS One*, *19*(9), e0309830. https://doi.org/10.1371/journal.pone.0309830

Otto, W. H., Coburn, J. W., Brown, L. E., & Spiering, B. A. (2012). Effects of Weightlifting vs. Kettlebell Training on Vertical Jump, Strength, and Body Composition. *Journal of Strength and Conditioning Research*, *26*(5), 1199–1202. https://doi.org/10.1519/JSC.0b013e31824f233e

Palmer, T. G., & McCabe, M. (2023). The Effect of a Novel Weight-Supported Kinetic Chain Resistance Training Program on Proximal Core Muscular Endurance, Trunk-to-Arm Muscular Power, and Bat Swing Speed. *Journal of Strength and Conditioning Research, 37*(11), 2130–2140. https://doi.org/10.1519/jsc.0000000000004520

Papry, F. A., Tishe, Z. H., Zahid, M. Z. I., Barman, A. K., & Shill, M. C. (2024). Sedentary Lifestyle and Prospective Health Risks: A Pilot Study Among Bangladeshi Corporate Professionals. *Bangladesh Pharmaceutical Journal*, *27*(1), 73–84. https://doi.org/10.3329/bpj.v27i1.71157

Park, J. H., Moon, J. H., Kim, H. J., Kong, M. H., & Oh, Y. H. (2020). Sedentary Lifestyle: Overview of Updated Evidence of Potential Health Risks. *Korean Journal of Family Medicine*, *41*(6), 365–373. https://doi.org/10.4082/kjfm.20.0165

Petřeková, K., Borzenko, N., Kovalová, M., & Gottfriedová, N. (2024). Assessment of Body Mass Index, Body Composition, Physical Activity, and Dietary Preferences in University Students: A Pilot Study. *Obesities*, *4*(1), 35–44. https://doi.org/10.3390/obesities4010004

Poutafkand, F., Marefati, H., & Taherichadorneshin, H. (2020). A Comparison of the Effects of Resistance and Endurance Training Protocols on Serum Irisin Level and Alkaline Phosphatase Activity in Sedentary Obese Women. *Polish Journal of Sport and Tourism*, *27*(4), 23–28. https://doi.org/10.2478/pjst-2020-0023

Radhika, A. H., & Shanmugavalli, T. (2024). Effect of kettle bells and battle rope training on grip strength and body composition among university volleyball players. *Salud, Ciencia y Tecnología - Serie de Conferencias*, *3*, 905. https://doi.org/10.56294/sctconf2024905

Rejeki, P. S., Pranoto, A., Rahmanto, I., Izzatunnisa, N., Yosika, G. F., Hernaningsih, Y., . . . & Halim, S. (2023). The Positive Effect of Four-Week Combined Aerobic–Resistance Training on Body Composition and Adipokine Levels in Obese Females. *Sports*, *11*(4), 90. https://doi.org/10.3390/sports11040090

Schranz, N., Tomkinson, G., & Olds, T. (2013). What is the Effect of Resistance Training on the Strength, Body Composition and Psychosocial Status of Overweight and Obese Children and Adolescents? A Systematic Review and Meta-Analysis. *Sports Medicine*, *43*(9), 893–907. https://doi.org/10.1007/s40279-013-0062-9

Sevilmis, A., Özdemir, İ., & García-Fernández, J. (2023). The History and Evolution of Fitness. *SPORT TK-Revista EuroAmericana de Ciencias Del Deporte, 12*, 4. https://doi.org/10.6018/sportk.493851

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, *52*(3–4), 591–611. https://doi.org/10.1093/biomet/52.3-4.591

Singh, C., Bandre, G., Gajbe, U., Shrivastava, S., Tiwade, Y., Bankar, N., & Moizuddin, K. (2024). Sedentary Habits and Their Detrimental Impact on Global Health: A Viewpoint. *National Journal of Community Medicine*, *15*(02), 154–160. https://doi.org/10.55489/njcm.150220243590

Spotswood, F., Steele, J., Androulakis-Korakakis, P., & Lucas, A. (2023). The dynamics of teleoaffective configuration in practice adaptation. *Marketing Theory, 24*(3), 499–524. https://doi.org/10.1177/14705931231207310

Stisen, A. B., Stougaard, O., Langfort, J., Helge, J. W., Sahlin, K., & Madsen, K. (2006). Maximal fat oxidation rates in endurance trained and untrained women. *European Journal of Applied Physiology*, *98*(5), 497–506. https://doi.org/10.1007/s00421-006-0290-x

Sun, F., Williams, C. A., Sun, Q., Hu, F., & Zhang, T. (2024). Effect of eight-week high-intensity interval training versus moderate-intensity continuous training programme on body composition, cardiometabolic risk factors in sedentary adolescents. *Frontiers in Physiology*, *15*, 1450341. https://doi.org/10.3389/fphys.2024.1450341

Tsuzuku, S., Kajioka, T., Endo, H., Abbott, R. D., Curb, J. D., & Yano, K. (2007). Favorable effects of non-instrumental resistance training on fat distribution and metabolic profiles in healthy elderly people. *European Journal of Applied Physiology*, *99*(5), 549–555. https://doi.org/10.1007/s00421-006-0377-4

Uddin, R., Lee, E.-Y., Khan, S. R., Tremblay, M. S., & Khan, A. (2020). Clustering of lifestyle risk factors for non-communicable diseases in 304,779 adolescents from 89 countries: A global perspective. *Preventive Medicine*, *131*, 105955. https://doi.org/10.1016/j.ypmed.2019.105955

Verbeke, G. (1997). Linear Mixed Models for Longitudinal Data. In P. Bickel, P. Diggle, S. Fienberg, K. Krickeberg, I. Olkin, N. Wermuth, & S. Zeger (Eds.), *Linear Mixed Models in Practice* (Vol. 126, pp. 63–153). Springer New York. https://doi.org/10.1007/978-1-4612-2294-1_3

Wackerhage, H., & Schoenfeld, B. J. (2021). Personalized, Evidence-Informed Training Plans and Exercise Prescriptions for Performance, Fitness and Health. *Sports Medicine, 51*(9), 1805–1813. https://doi.org/10.1007/s40279-021-01495-w

Westphal, S. A. (2008). Obesity, Abdominal Obesity, and Insulin Resistance. *Clinical Cornerstone*, *9*(1), 23–31. https://doi.org/10.1016/S1098-3597(08)60025-3

Wewege, M. A., Desai, I., Honey, C., Coorie, B., Jones, M. D., Clifford, B. K., . . . & Hagstrom, A. D. (2022). The Effect of Resistance Training in Healthy Adults on Body Fat Percentage, Fat Mass and Visceral Fat: A Systematic Review and Meta-Analysis. *Sports Medicine*, *52*(2), 287–300. https://doi.org/10.1007/s40279-021-01562-2