Rohilkhand Journal of AYUSH Research

Original Research

Effect of *Dandaal*, a traditional Indian yogic exercise, on anthropometric measures and body composition in young overweight and obese adult males: a randomized controlled trial

Vishwesh S. Shet*1, Swathi K. V. 2, Vanitha S. Shetty 3

1* Post Graduate Scholar, Department of Clinical Yoga, Alva's College of Naturopathy and Yogic Sciences, Karnataka, India 574225.

2 Associate Professor, Department of Clinical Yoga, Alva's College of Naturopathy and Yogic Sciences, Karnataka, India 574225.

3 Principal of the Institution, Alva's College of Naturopathy and Yogic Sciences, Karnataka, India 574225.

DOI: https://doi.org/10.65001/RJAR.2026.V2I104

ABSTRACT:

Background and Objectives:

Excessive adiposity increases the risk of developing metabolic and cardiovascular diseases. *Dandaal*, also popularly known as *'Dands'* among Westerners, is a traditional Indian physical exercise that shares a considerable similarity to *Surya namaskar* and is believed to be its precursor. However, scientific evidences regarding its effect in managing excess adiposity is scarce. This study investigated how *Dandaal* practice impacts anthropometric and body composition parameters in overweight and obese young adult males.

Methods:

Sixty-six overweight and obese males (18-25 years) were randomly assigned to study group (n=33) or passive control group (n=33). The study group practiced a structured 40-minute yoga protocol which included *Dandaal* for 4 weeks. Anthropometric (body mass index, waist circumference, and waist-to-height ratio), and body composition (fat-free weight, subcutaneous fat, visceral fat, muscle mass, and body fat percentage) parameters were assessed at baseline and post intervention. Ethical approval, trial registration (CTRI/2026/01/100462) and informed consent was obtained.

Results:

Our findings showed that study group showed a reduction in BMI (P=0.007) and increase in muscle mass (P=0.002) compared to control group. A marked reduction in body fat percentage within study group (P=0.004) and between groups (P=0.009) was observed. No adverse events or dropouts were reported.

Conclusion:

Four weeks of *Dandaal* practice was associated with favourable changes in anthropometric measures and body composition among young overweight and obese adult males. *Dandaal* may be a safe and feasible yoga-based, Indian traditional physical conditioning practice, for management of excess adiposity.

Keywords: - *Dandaal, Surya Namaskar, Yoga, Overweight, Anthropometry, Body Composition*

INTRODUCTION:

Excessive adiposity has become one of the significant health problems in the recent years with rates of incidence increasing than ever before [1]. Overweight and obesity are caused as a result of excessive fat accumulation, whether globally, regionally, or as ectopic lipids, which is seen to increase the risk of negative health effects [2]. According to Endocrine Society of India, obesity is defined as a chronic, relapsing progressive disease defined by excessive adiposity that may impair health [3]. World Health Organisation (WHO) defines overweight and obesity as BMI (Body Mass Index) more than or equal to 25 kg/m2 and 30 kg/m2 respectively for adults. WHO has recognized obesity as a chronic, recurring condition which is a result of complex inter play involving genetics, neurobiology, dietary habits, availability of nutritious food, economic influences and overall environment [1]. Low-middle income countries such as India are witnessing a huge growth in the incidence rates of overweight and obesity among all age groups, ranging from young children to teens and adults. Conventionally, the screening of obesity is assessed using anthropometry, mainly BMI. According to WHO, for Asian population, the BMI values for overweight is 23–24.9 kg/m2 and for obesity is ≥25 kg/m2 [4]. Considering the possible risk of misdiagnosis of obesity by BMI alone, other alternative measures such as waist circumference (WC), waist-to-height ratio (WHtR), bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DEXA), etc. are being employed for more accurate measurement of fat mass and its distribution [5-6].

Lifestyle modifications, mainly dietary regulation and physical exercises are recommended as first-line interventions in management of obesity [7]. Yoga, is a Mind-Body intervention incorporates physical poses, breathwork, meditation and relaxation techniques. It has triggered an interest worldwide mainly due to its low cost, minimal adverse effects and ease of practice among others [8]. Physical education for overall development of ones' personality has been taught and practiced in India since ages [9]. One among such practices is the infamous *'Surya Namaskar'* (SN) or the 'Sun Salutation'. The SN was not a part of traditional Yoga practice. It is believed to have been developed and promoted in 1920s by King of *Aundh, Late Shrimant Balasaheb Pant Pratinidhi* and subsequently by Sri K. V. Iyer and Sri T. Krishnamacharya [10]. SN is a Yogic technique which comprises of 12 physical postures with awareness on breath and mind [11]. Its effects are similar to aerobic exercises when practiced at a faster pace and as yoga practice with mind-breath-body awareness when practiced at slower pace [12].

Dandaal, which is believed to be the origin of

modern variants of push-ups practiced by fitness enthusiasts all over the world today, forms the fundamental part of SN. *Dandaal* practice comprises of, *Parvatasana* (mountain pose), *Ashtanga namaskara* (salute with eight parts) and *Bhujangasana* (mountain pose) [10]. It resembles a form of exercise which is well known in English as Dands, Hindu push-ups, Jack knifing push-ups etc. *Dands* is practiced widely as a core regimen in traditional wrestling *(Mallavidya* or *Pahalwani)*, often paired with sit-ups *(Baithak)* for physical fitness. Among different types of *Dands*, the *Sadharan Dand* closely resembles the *Dandaal* postures of SN [13-14].

Several scholarly articles have summarised the health benefits of practicing SN highlighting its effects in improving cardiorespiratory fitness, muscle strength, relaxation, stress reduction, pulmonary function and metabolic health [9-10][15]. Despite *Dandaal* being considered the precursor of SN technique, the evidence of its effects in health conditions is limited. Few studies have assessed the effect of *Dandaal* or *Dands* practice on physical fitness variables like muscular strength and flexibility [16-18]. However, no research has been conducted that explores the effect of practice of *Dandaal* in overweight and obese population. Thus, the present study aimed to explore the effects of *Dandaal* on anthropometric measures and body composition in young overweight and obese adults.

METHODOLOGY

Subjects

A total of 150 healthy young adult males were screened for eligibility from an integrated Naturopathy and Yoga hospital located in Southern part of India, out of which 66 participants were found eligible for the study after applying inclusion and exclusion criteria. The sample size was estimated using G*Power software; version 3.1.9 based on similar previous research [19]. Considering 2-sided p value 1:1, allotment ratio for 85% power, with 5% level of significance and effect size of 0.8, the sample size was determined to be 60 subjects. Considering an attrition rate of 10%, the total sample size for the study was found to be 66 (33 each in 2 groups).

Inclusion criteria

- Male adults of age group 18-25 years old.
- Individuals with BMI values in the category of overweight or obese based on WHO Asian BMI Classification.
- Individuals who voluntarily agreed and consented to participate in the study.

Exclusion criteria

- Individuals with hypertension, history of recent surgery, suffering from any acute illness or on any medications at the time of study.
- Individuals involved in substance abuse which includes alcohol, tobacco and illegal drugs.
- Individuals who were enrolled in any other study at the time of recruitment.

Study Design

The study was an open-label, randomized, controlled trial. The participants were randomly assigned in either study group (n=33) or control group (n=33) using lottery method. Each of the participant was assigned a unique number which ranged from 1 to 66. Identical slips were placed in a box, and 33 slips were selected by an independent person who was not a part of the study. The chosen subjects were placed in the experimental group (n=33), while the rest of the subjects were placed in the control group (n=33). Except for the height, all other assessments were recorded at two timepoints; at the beginning of the study (baseline) and the end of the study (post data). The data was collected by an assessor who was blinded to participants group allocations (single-blinded).

Ethical Considerations

The participants were priorly explained about the procedures of the study, purpose of conducting this research and about their rights to withdraw from the study at any time without any obligation. The informed consent form was made available in both English or regional language based on participants preferred language, and any queries raised were clarified prior to obtaining the consent form. The individuals who showed their willingness to participate in the study by signing informed consent form were recruited for the study. Ethical approval for the study was obtained from the institutional ethics committee (Ref. No.: ACNYS/IECHS/2025/89) and the trial was prospectively registered with the Clinical Trials Registry-India (CTRI/2026/01/100462).

Intervention

Yoga intervention

The study group engaged in the specified yoga protocol which consisted for loosening exercises, *Dandaal* practice and supine rest (Table 1), daily in the evening between 4-6 pm for a duration of 28 days (4 weeks), six days per week. The participants attended one supervised session per day which lasted for about 40 minutes. Attendance was recorded to check for adherence.

1. Sukshma Vyayama [20]

These are loosening exercises practiced at the beginning of the session to reduce the joint stiffness and improve microcirculation. It encompasses a systematic sequence of exercises practised with breath awareness. The exercises are practiced sequentially with gradual progression from the head to the toes. It includes neck movements: forward and backward bending, right and left bending, right and left twisting, neck rotation; shoulder movements: shoulder stretch, shoulder rotation; trunk movement; knee movement.

2. Dandaal [21]

- **Step-1 *(Ashtanga namaskara)*:** This is the starting position to begin with. Assume prone position, with only the toes, knees, chest, hands and chin in contact with the ground.

Breathing: External Breath Retention

- **Step-2** ***(Bhujangasana)*****:** From Step-1, inhaling move the chest forward and upward simultaneously lifting the head and shoulders. Then, straighten the elbows, arch the back, further lifting the head and eyes gazing upwards. The thighs, knees and hips should remain in contact with the floor.

Breathing: Inhalation

- Step-3 ***(Parvatasana):*** From Step-2, exhaling arch the body back by lifting the hips simultaneously lowering the head between the arms, creating a triangle shape with the back and legs. In the final position, the arm and legs should be straight.

Breathing: Exhalation

- Completion of one round of Step 1, 2 and 3 counts as one repetition. Practice this for 10 repetitions continuously to complete 1 set, followed by 1 minute rest period. Practice for a total of 12 sets.
- Practice rhythmically with mindful breath awareness for each sequence and at a steady pace. (Figure 1)

3. Relaxation in *Shavasana* [21]

- Lie down on your back with the arms placed besides the body, palms facing upwards. Allow the finger to slightly curl up.
- Adjust the position of the feet to a comfortable distance apart and gently shut your eyes.
- Ensure that the head and spine are in a straight line. The head should be balanced in comfortable position but should not tilt to either side.
- Consciously stop all the physical movements and relax your whole body. Focus on the natural flow of breath, allowing it to flow rhythmically and effortlessly. This posture is called as corpse pose in English.
- After a while, become aware of the body and surroundings. Gradually and gracefully release the posture and come to sitting posture.

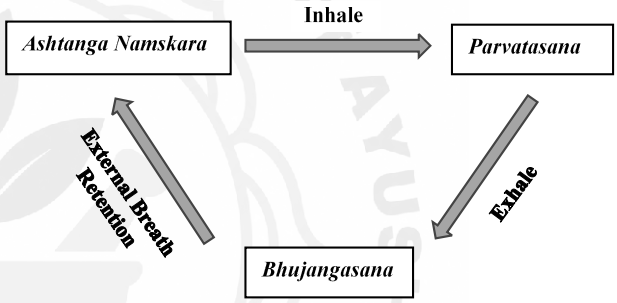


Figure 1: Asanas in one Dandaal practice cycle

Control intervention

Control group followed their usual routine activities and did not receive any intervention during the study duration.

Participants of both the groups were given general dietary advice and were asked to follow their usual dietary practices and routine physical activities till the end of the study to reflect real-world conditions.

Outcome variables

Primary variables included three anthropometric measures (body mass index, waist circumference and waist-to-height ratio) and secondary variables included five body composition parameters (fat free weight,

subcutaneous fat, visceral fat, muscle mass and body fat percentage). Participants height and weight were measured for calculation of anthropometric measures, but were not considered as outcome variables for this study. All the assessments were conducted on an empty stomach at the same time of day in the early morning at baseline and at the end of study duration.

Anthropometric measures

Body mass index (BMI)

It is a widely used diagnostic indicator for obesity. It is calculated as the ratio of body mass (kg) to the square to height (m2) [22]. Height was measured in centimetres using a stadiometer and standard digital weighing machine (Dr. Trust®) was used to record the nearest 0.1 kg. Since the study was conducted in India, the BMI cutoffs for Asian population proposed by WHO Expert Consultation, 2004 was used [23]. (Table 2)

Table 2: World Health Organization Asian population BMI criteria [23]:

Grading	BMI range
Underweight	<18.5 kg/m^2
Normal weight	18.5-22.9 kg/m^2
Overweight	23-24.9 kg/m^2
Obese I	25-29.9 kg/m^2
Obese II	=30 kg/m^2

Waist circumference (WC)

It is a simple anthropometric measure for assessing obesity. It is recorded by measuring the narrowest circumference of the waist [22]. It shows a strong correlation with abdominal fat accumulation [24]. A standard non-stretchable tape was employed to measure the narrowest circumference of the waist. It was recorded to the closest centimetre. The WC values greater than 90 cm in men and 80 cm in women are considered as cutoff for indicating obesity for Indian population [3].

Waist-to-height ratio (WHtR)

It is also known as Index of Central Obesity (ICO). It is defined as the ratio of WC (cm) to the height (cm). It estimates the distribution of body fat [22]. It has better prognostic value compared to the BMI and WC in prediction of metabolic risk [25]. WHtR less than 0.5 is considered as normal or low risk, whereas anything equal to or above 0.5 suggests increased cardiometabolic risk [24].

Body Composition parameters

It was recorded using the Bioelectrical Impedance Analysis (BIA) based device; Dr Trust® USA Smart Body Fat and Body Composition Scale Analyser 2.0 for Body Weight 509 (USFDA and CE approved). The device estimates values of parameters based on prediction algorithms [26].

Fat free weight (FFW)

It is estimated by subtracting fat mass from total body fat. It is described in different age groups as nutritional status indicator, with low FFW indicating higher risk of mortality. It is

dependent on age, sex and ethnicity [22].

Subcutaneous fat (SF)

SF acts as a physiological buffer for excess calorie intake with low energy expenditure. It is when the storage ability of SF is exceeded or its ability to produce new adipocytes is deranged due to various causes that the fat begins to accumulate in areas other than subcutaneous tissue. Around 80% of the total body fat is in the subcutaneous tissue [27].

Visceral fat (VF)

The adiposity accumulated in mesentery and omentum is called as VF. Inflammatory cells mainly the macrophages are greater in VF than compared to SF. It accounts for about 10-20% of total body fat in males and 5-8% in females. The increase in VF is directly proportional to aging in both genders [27].

Muscle mass (MM)

It refers to the skeletal muscle mass in the body. MM is important for homeostasis of glucose metabolism and is considered as a major metabolic health biomarker [28].

Body fat percentage (BF)

BF along with BMI, VF and WC showed positive correlation in cardiometabolic disorders [27]. According to WHO the BF > 25% in males and > 35% in females are considered the gender-wise cutoff for diagnosing obesity [29].

Data analysis

The data was analysed using jamovi 2.6.44 software for statistical analysis. Microsoft Excel 2021 was used for generation of graphs. The continuous variables were represented in mean ± standard deviation (SD). Shapiro-Wilk test was employed to assess the normality of the data.

Statistical tests

Since the data did not follow normal distribution ($P < 0.05$), non-parametric statistical tests were conducted. Within-group comparisons between pre and post intervention values were analysed using Wilcoxon Signed-Rank test. Between-group comparisons were analysed using Mann–Whitney U test. Statistical significance was set at $P < 0.05$.

RESULTS

The CONSORT flow diagram of the study is shown in Figure 2. No dropouts or adverse events were reported as this was a short duration study. The two groups, yoga and control (n=33 each), had similar demographic characteristics (Table 3). The baseline data of the variables were not normally distributed and baseline differences were observed in some variables between the groups which were considered while interpreting the results. Thus, non-parametric statistical tests were employed.

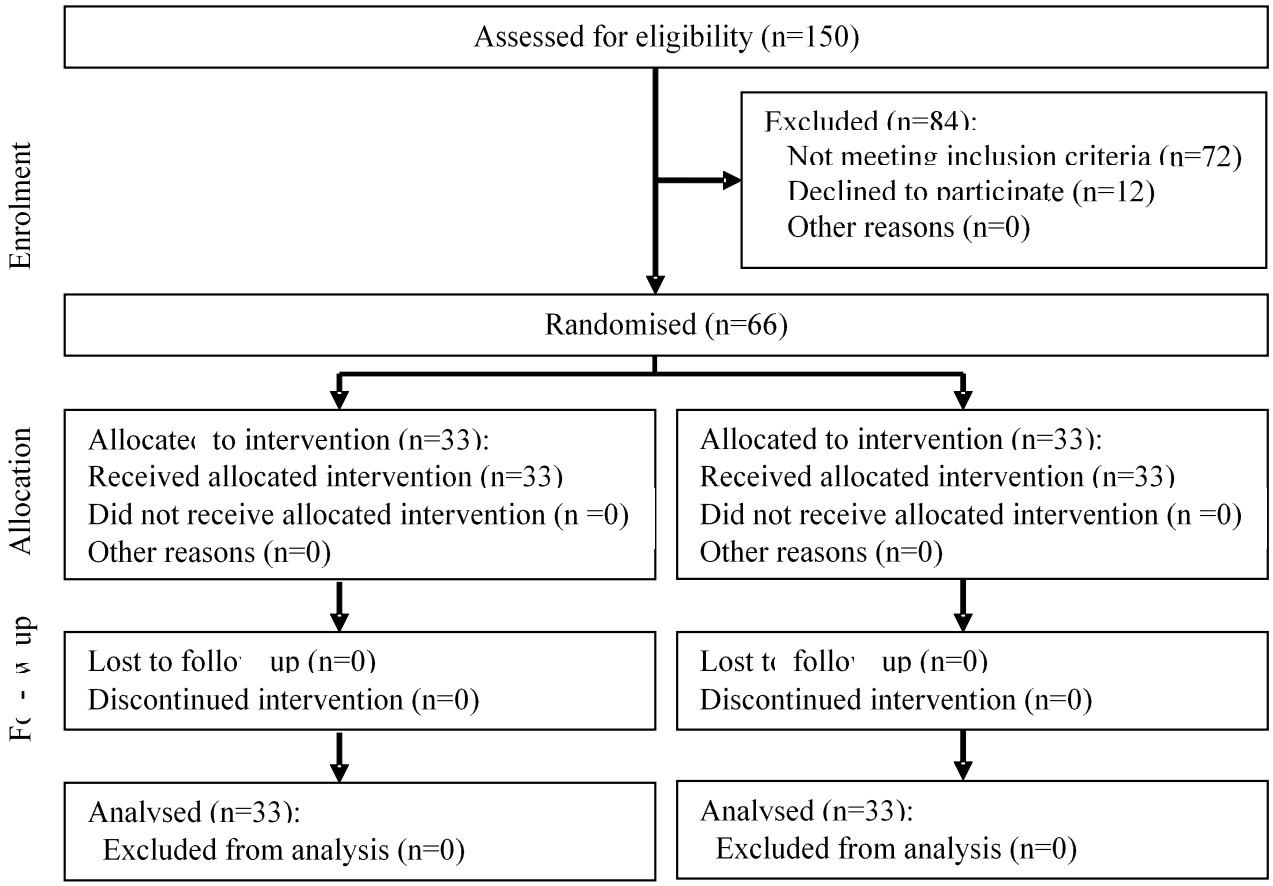


Figure 2: CONSORT flow diagram of the study

Table 3: Demographic characteristics of the Participants.

Characteristics	Study group	Control group
N	33	33
Age (Mean ±SD)	22.3 ± 1.64	22.7 ± 1.90

Within-group comparison

a) Study group

Within-group analysis of the study group showed a marginal reduction in BMI from 25.36 ± 2.49 kg/m² to 25.34 ± 2.50 kg/m²; however, this change was not statistically significant (P=0.371).

FFW increased slightly from 57.95 ± 2.55 kg to 58.02 ± 2.55 kg, but the change was not statistically significant (P=0.167). Similarly, SF decreased from 17.47 ± 2.65% to 17.34 ± 2.67%, although the difference was not statistically significant (P=0.058).

A statistically significant increase in MM was observed following the intervention, which showed an increase from 55.12 ± 2.36 kg to 55.34 ± 2.36 kg (P=0.002). Furthermore, BF also demonstrated a significant reduction from 22.25 ± 4.48% to 22.09 ± 4.51% (P=0.004). No measurable changes were recorded in WC, WHtR, or VF during the intervention period (Figure 3).

b) Control group

Within-group analysis of the control group demonstrated a statistically significant increase in BMI from 25.44 ± 1.27 kg/m² to 25.49 ± 1.26 kg/m² (P=0.012).

FFW showed a significant increase from 58.16 ± 1.92 kg to 58.30 ± 1.97 kg (P=0.036). Significant reductions were recorded in SF, which decreased from 17.34 ± 1.97% to 17.22 ± 1.90% (P=0.036), and BF, which decreased from 23.45 ± 3.12% to 23.33 ± 3.09% (P=0.036). No measurable changes were observed in WC, WHtR, VF, or MM.

Table 4: Within-group comparison of pre- and post-intervention anthropometric and body composition measurements for both groups.

Group	Variable	Pre Mean ± SD	Post Mean ± SD	Test Statistic (Wilcoxon W)	*P*-Value
Study Group	BMI (kg/m²)	25.36 ± 2.49	25.34 ± 2.50	3.0	0.371
	WC (cm)	95.33 ± 5.46	95.33 ± 5.46	-	-
	WHtR	0.557 ± 0.029	0.557 ± 0.029	-	-
	FFW (kg)	57.95 ± 2.55	58.02 ± 2.55	13.5	0.167
	SF (%)	17.47 ± 2.65	17.34 ± 2.67	38.5	0.058
	VF (%)	11.69 ± 2.28	11.69 ± 2.28	-	-
	MM (kg)	55.12 ± 2.36	55.34 ± 2.36	0.0	0.002*
	BF (%)	22.25 ± 4.48	22.09 ± 4.51	66.0	0.004*
Control Group	BMI (kg/m²)	25.44 ± 1.27	25.49 ± 1.26	33.0	0.012*
	WC (cm)	95.82 ± 3.96	95.82 ± 3.96	-	-
	WHtR	0.560 ± 0.020	0.560 ± 0.020	-	-
	FFW (kg)	58.16 ± 1.92	58.30 ± 1.97	0.0	0.036*
	SF (%)	17.34 ± 1.97	17.22 ± 1.90	21.0	0.036*
	VF (%)	12.10 ± 1.13	12.10 ± 1.13	-	-
	MM (kg)	55.35 ± 1.77	55.35 ± 1.77	-	-
	BF (%)	23.45 ± 3.12	23.33 ± 3.09	21.0	0.036*

*Statistically significant at $P < 0.05$

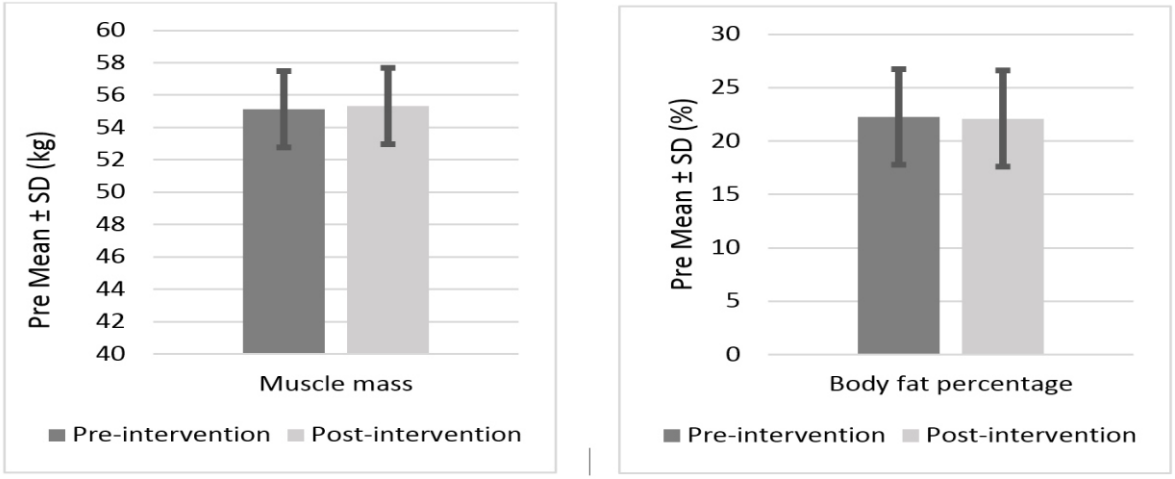


Figure 3: Pre- and post-intervention comparison of muscle mass (MM) and body fat percentage (BF) in the study group.

Between-group comparison

Post-intervention comparison between the study and control groups revealed statistically significant differences in BMI, WHtR, VF and BF. The post-intervention BMI was significantly lower in the study group (25.34 ± 2.50 kg/m²) compared with the control group (25.49 ± 1.26 kg/m²) (Mann–Whitney U=336, P=0.007). Similarly, WHtR was significantly lower in the study group (0.557 ± 0.029) than in the control group (0.560 ± 0.020) (U=374, P=0.029). VF was found to be significantly lower in the study group (11.69 ± 2.28) when compared to the control group (12.10 ± 1.13) (U=354, P=0.015). BF also showed significant reduction in the study group (22.09 ± 4.51%) than in the control group (23.33 ± 3.09%) (U=341, P=0.009). No significant differences were observed between the groups with respect to WC (P=0.207), FFW (P=0.287), SF (P=0.653), or MM (P=0.827) (Figure 4).

Table 5: Post-intervention outcomes between the two groups.

Variable	Post Mean ± SD (Study)	Post Mean ± SD (Control)	Test Statistic (Mann–Whitney U)	*P*-Value
BMI (kg/m²)	25.34 ± 2.50	25.49 ± 1.26	336	0.007*
WC (cm)	95.33 ± 5.46	95.82 ± 3.96	447	0.207
WHtR	0.557 ± 0.029	0.560 ± 0.020	374	0.029*
FFW (kg)	58.02 ± 2.55	58.30 ± 1.97	461	0.287
SF (%)	17.34 ± 2.67	17.22 ± 1.90	509	0.653
VF (%)	11.69 ± 2.28	12.10 ± 1.13	354	0.015*
MM (kg)	55.34 ± 2.36	55.35 ± 1.77	527	0.827
BF (%)	22.09 ± 4.51	23.33 ± 3.09	341	0.009*

*Statistically significant at $P < 0.05$

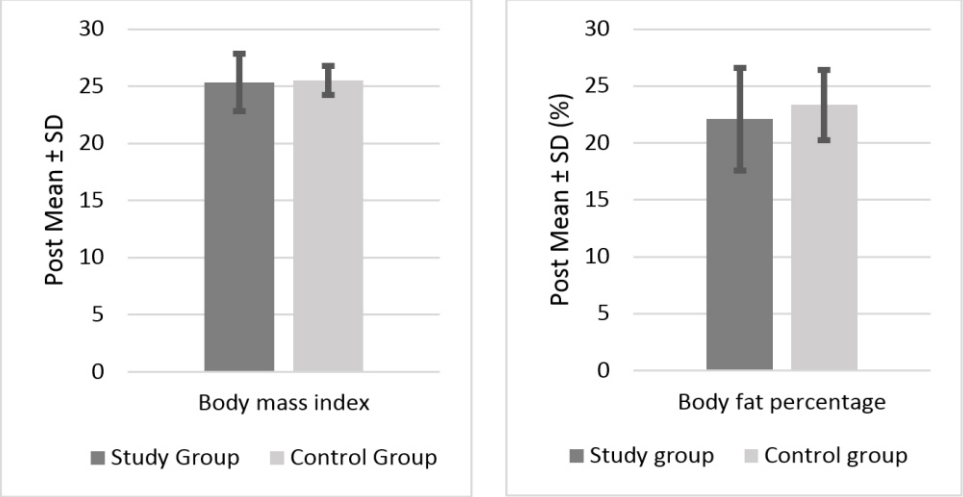


Figure 4: Post-intervention comparison of body mass index (BMI) and body fat percentage (BF) between the study and control groups

DISCUSSION

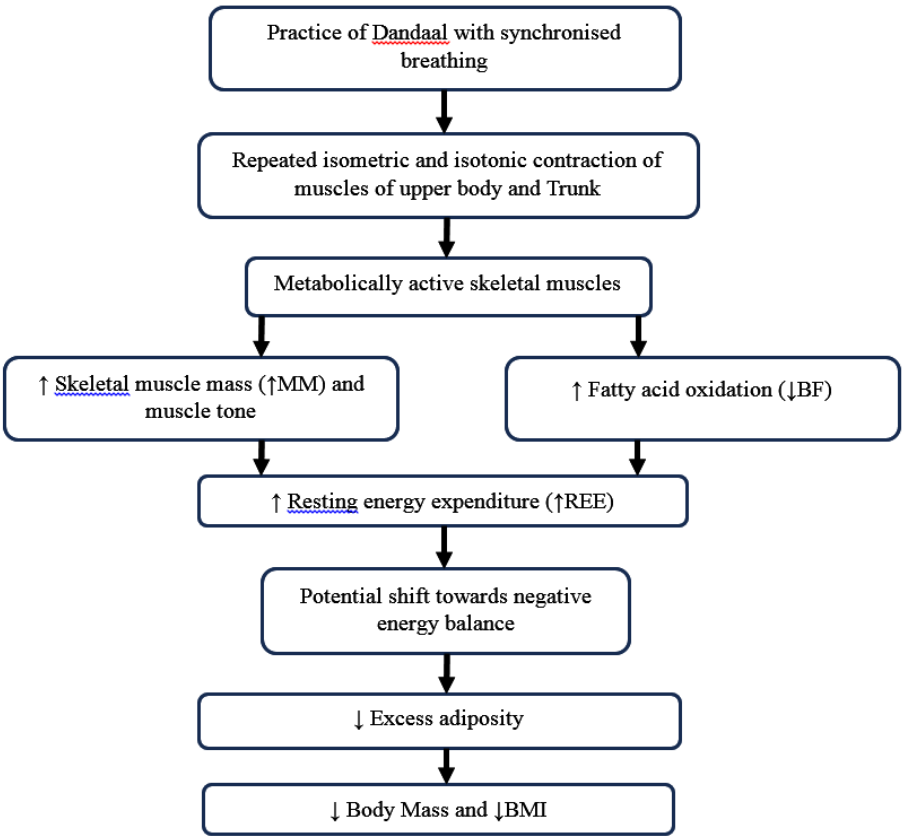
The findings of this study showed that 28 days (4 weeks) of *Dandaal* practice resulted in significant changes in body composition measures as compared to the anthropometric measures. Among multifactorial causes of obesity, a person with deficient resting energy expenditure (REE) is at higher risk for gaining weight. Individuals with metabolically active skeletal muscles tend to consume more energy at rest thus mitigating the risk of weight gain over a period [30]. The participants in the study group demonstrated a significant increase in MM and a significant reduction in BF following the intervention. The changes in MM can be attributed to increase upper body muscular strength and endurance, a finding consistent with bodyweight training exercises like push-ups. The dynamic and repetitive movements from *Dandaal* indicate an inherent engagement in muscles of shoulders, chest, arms and core thus improving its endurance [18]. The muscles that are mainly engaged during the practice of *Dandaal* are latissimus dorsi, lower trapezius, erector spinae and gastrocnemius [31]. These muscles have relatively high proportion of fatigue-resistant fibres (Type I) [32-34]. Type I fibres have higher mitochondrial density and contain substantial oxidative, fatigue-resistant muscle fibres which positively correlates to enhanced oxidative activity. These muscle fibres utilise carbohydrates and fatty acid oxidation as main sources of energy for sustained low-to-moderate intensity activity which may have contributed to the relative decrease in body fat within the study group [35]. However, overweight and obese individuals tend to have lower proportion of Type I fibres, which may explain the modest changes in MM and BF (Figure 5) [36]. In contrast to conventional exercises, *Dandaal* was performed with mindful awareness on breathing which is an essential feature of any yogic practice. While between-group differences in BMI and BF was significant, no significant changes were observed in anthropometric measures (BMI, WC, WHtR) and body composition measures (FFW, SF and VF), except for BF and MM in within-group analysis.

Control group showed a significant increase in BMI and FFW. Also, there was a slight decrease in SF and BF, while majority of the remaining parameters remained unchanged. The increase in BMI and FFW may be due to lack of recording of calorie intake and non-compliance of the recommended dietary habits among other factors. Post-intervention, there was a modest decrease in BF and BMI in study group compared to the control group. This implies *Dandaal* practice may have beneficial effects in reduction of excess adiposity in comparison with control group.

In the present study, the magnitude of the

changes observed due to intervention was modest. Thus, the practical significance of these changes may be limited despite the observation of statistically significant outcomes. The key strength of the present study is that it addresses a significant research gap in the existing literature by exploring the effects of practice of *Dandaal* specifically in overweight and obese population. Furthermore, this study bridges traditional Indian physical conditioning with contemporary yoga techniques by demonstrating Dandaal practice as a convenient, low risk and feasible practice for positive health outcomes. Smaller sample size, shorter study duration, only male participation, passive control group, lack of follow up and lack of controlled setting to prevent influence of confounding factors suggest that the findings of the study are preliminary, requiring further studies to establish the clinical relevance in the overweight and obese population. Overall, the findings suggested that *Dandaal* may contribute to manage excessive adiposity by bringing about positive alterations in body composition, particularly through increasing lean muscle mass and reducing overall body fat.

Figure 5: Hypothesised mechanisms underlying the potential effects of Dandaal in managing excess adiposity.



CONCLUSION

The study concludes that *Dandaal* practice may contribute to manage excess adiposity by bringing about positive alterations in anthropometric and body composition measures, particularly through increases in lean muscle mass and reductions in body mass index and body fat percentage. Although certain anthropometric and body composition outcomes remained below the threshold for statistical significance, the overall pattern of favourable results support the effectiveness of *Dandaal* as a simple, feasible and low-risk yoga-based intervention for the management of overweight and obesity. Future research involving larger, gender-inclusive samples across diverse age groups is recommended to validate these effects and investigate broader clinical applications of this intervention.

ACKNOWLEDGMENTS

We are thankful to Dr. Divine King J for helping with statistical analysis of this study. We are also grateful to Dr. Archana K and Dr. Sharada Shetty P S for their valuable support.

FUNDING STATEMENT

This study was self-funded. No external financial support was received.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. World Health Organization. Obesity and overweight. Geneva: World Health Organization; 2025 [cited 2026 Apr 30]. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
2. Purnell JQ. Definitions, classification, and epidemiology of obesity. Bethesda (MD): National Library of Medicine; [cited 2026 May 4]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK279167/
3. Madhu SV, Nitin K, Sambit D, Nishant R, Sanjay K. ESI clinical practice guidelines for the evaluation and management of obesity in India. Indian J Endocrinol Metab. 2022;26(4):295–318.
4. Misra A. Ethnic-specific criteria for classification of body mass index: a perspective for Asian Indians and American Diabetes Association position statement. Diabetes Technol Ther. 2015;17(9):667–71.
5. Rubino F, Cummings DE, Eckel RH, Cohen RV, Wilding JPH, Brown WA, et al. Definition and diagnostic criteria of clinical obesity. Lancet Diabetes Endocrinol. 2025;13(3):221–62.
6. Mallik R, Carpenter J, Zalin A. Assessment of obesity. Clin Med (Lond). 2023;23(4):299–303.
7. Werndle VV, Stefanovic J, Reljic D. Comparative effects of diet, exercise, and pharmacotherapy on metabolic syndrome

severity in overweight and obese cohorts: a systematic review and meta-analysis. Nutrients. 2026;18(3):473.

8. Wasityastuti W, Pramaningtyas MD, Wibowo RA, Adnan ML, Prabowo R, Tsurayya Z, et al. Impact of yoga on cardiometabolic health in adults with overweight or obesity: A systematic review and meta-analysis of randomized controlled trials. PLOS Global Public Health. 2026;6(4):e0006174.
9. Stec K, Kruszewski M, Ciechanowski L. Effects of suryanamaskar, an intensive yoga exercise routine, on the stress levels and emotional intelligence of Indian students. Int J Environ Res Public Health. 2023;20(4):2845.
10. Prasanna Venkatesh L, Vandhana S. Insights on Surya namaskar from its origin to application towards health. J Ayurveda Integr Med. 2022;13(2):100530.
11. Suwannakul B, Sangkarit N, Thammachai A, Tapanya W. Effects of Surya Namaskar yoga on perceived stress, anthropometric parameters, and physical fitness in overweight and obese female university students: A randomized controlled trial. Hong Kong Physiother J. 2025;45(1):23–33.
12. Bhavanani AB, Udupa K, Madanmohan, Ravindra P. A comparative study of slow and fast suryanamaskar on physiological function. Int J Yoga. 2011;4(2):71–6.
13. Gandhi G, Kumar P. The capillary blood in-vivo micronucleus test: wrestlers exercising at akharas. Journal of Exercise Science and Physiotherapy. 2007;3(2):129–35.
14. Khabiruddin S, Mondal S. Documentation of Indian traditional dand exercise. Int J Creat Res Thoughts. 2022;10(1):a554-a562.
15. Bhutkar MV, Bhutkar PM, Taware GB, Surdi AD. How effective is sun salutation in improving muscle strength, general body endurance and body composition? Asian J Sports Med. 2011;2(4):259–66.
16. Gurunathan M. Effects of isolated and combined training of dands baithaks and yogasanas on specific physical and physiological variables among school boys. Chennai: Tamil Nadu Physical Education and Sports University; 2014.
17. Dhokrat GK. Effect of traditional exercises on selected health related physical fitness components of junior college boys. Scholarly Research Journal for Humanity Science & English Language. 2017;4(19):4292-4298.
18. Jaiswal R, Mishra K, Dubey R, Ghildyal S. Evaluating the effects of Dand and Baithak on health-related physical fitness: A traditional exercise perspective. International Journal of Environmental

Sciences. 2025;11(19s):1265-71

19. Devi G, Swathi KV, Archana K, Devi BB, Singh J. Effect of Suryanamaskara and Heating Pranayama on Grade 1 Obesity - A Randomized Controlled Trial. Journal of Ayurveda and Integrated Medical Sciences. 2024;9(1):23–31.
20. Ministry of Ayush, Government of India. Common yoga protocol. New Delhi: Ministry of Ayush; 2026 [cited 2026 Apr 11]. Available from: https://yoga.ayush.gov.in/uploads/assets/cyp/CYP_Book_English_2026.pdf
21. Saraswati S. Asana Pranayama Mudra Bandha. 4th ed. Munger: Bihar School of Yoga; 2009.
22. Piqueras P, Ballester A, Durá-Gil JV, Martinez-Hervas S, Redón J, Real JT. Anthropometric indicators as a tool for diagnosis of obesity and other health risk factors: a literature review. Front Psychol. 2021;12:631179.
23. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;363(9403):157-163.
24. Browning LM, Hsieh SD, Ashwell M. A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0·5 could be a suitable global boundary value. Nutr Res Rev. 2010;23(2):247–69.
25. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. Obes Rev. 2012;13(3):275–86.
26. Campa F, Coratella G, Cerullo G, Noriega Z, Francisco R, Charrier D, et al. High-standard predictive equations for estimating body composition using bioelectrical impedance analysis: a systematic review. J Transl Med. 2024;22(1):515.
27. Ibrahim MM. Subcutaneous and visceral adipose tissue: structural and functional differences. Obes Rev. 2010;11(1):11–8.
28. Lee M, Jebb SA, Oke J, Piernas C. Reference values for skeletal muscle mass and fat mass measured by bioelectrical impedance in 390 565 UK adults. J Cachexia Sarcopenia Muscle. 2020;11(2):487–96.
29. Romero-Corral A, Somers VK, Sierra-Johnson J, Thomas RJ, Bailey KR, Collazo-Clavell ML, et al. Accuracy of body mass index to diagnose obesity in the US adult population. Int J Obes (Lond). 2008;32(6):959–66.
30. Zurlo F, Larson K, Bogardus C, Ravussin E. Skeletal muscle metabolism is a major determinant of resting energy expenditure.

J Clin Invest. 1990;86(5):1423–7.

31. Mullerpatan RP, Agarwal BM, Shetty TV. Exploration of muscle activity using surface electromyography while performing surya namaskar. Int J Yoga. 2020;13(2):137-143.
32. Johnson MA, Polgar J, Weightman D, Appleton D. Data on the distribution of fibre types in thirty-six human muscles. An autopsy study. J Neurol Sci. 1973;18(1):111–29.
33. Lindman R, Eriksson A, Thornell LE. Fiber type composition of the human male trapezius muscle: enzyme-histochemical characteristics. Am J Anat. 1990;189(3):236–44.
34. Paoli A, Pacelli QF, Cancellara P, Toniolo L, Moro T, Canato M, et al. Myosin isoforms and contractile properties of single fibers of human latissimus dorsi muscle. Biomed Res Int. 2013;2013:249398.
35. Dong H, Tsai SY. Mitochondrial properties in skeletal muscle fiber. Cells. 2023;12(17):2183.
36. Damer A, El Meniawy S, McPherson R, Wells G, Harper ME, Dent R. Association of muscle fiber type with measures of obesity: A systematic review. Obes Rev. 2022;23(7):e13444.

Cite this article as (NLM):
Shet VS, Swathi KV, Shetty VS. Effect of Dandaal, a Traditional Indian Yogic Exercise, on Anthropometric Measures and Body Composition in Young Overweight and Obese Adult Males: A Randomized Controlled Trial. Rohilkhand Research. 2026 Mar-Aug;2(1):33-48. doi:10.65001/RJAR.2026.V2I1N4

Corresponding author: ***dr.shetvishwesh@gmail.com***

Submitted: 13/07/2026 | *Revised:27/07/2026* | *Accepted:20/08/2026* | *Published:30/09/2026*