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Effect of dual-task training on postural stability in obese individuals: a randomised controlled trial

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Abstract

Introduction. Obesity has been linked to adverse postural stability parameters that can negatively impact balance. While studies have demonstrated the benefits of dual-task (DT) training on postural stability, these benefits have not been observed in obese individuals. Therefore, this study aims to compare the effects of DT training with different prioritisation on postural stability in obese individuals.
Methods. 35 subjects were randomised to one of 3 groups: DT – variable priority (VP), DT – fixed priority (FP), and a single-task training group. Centre of pressure (CoP) sway, CoP range, and reaction time were assessed using a Pedalo®-Sensamove balance device. Balance was determined using the timed up and go (TUG) and TUG-Cog tests, and the Berg balance scale (BBS) before and after 8 weeks of intervention programs.
Results. The results showed a significant improvement in all outcome variables after eight weeks of intervention (effect of time, $p < 0.05$), with no significant difference between the groups (effect of group, $p > 0.05$). When comparing the mean differences in CoP sway, range, and TUG-Cog, statistically significant results were obtained in the variable priority group compared to the fixed-priority group.
Conclusions. The findings of this research imply that engaging in DT training can enhance postural stability and balance in obese individuals, regardless of whether the instructional set is of the variable- or fixed-priority variety. Nevertheless, these outcomes were not established to surpass those achieved through conventional single-task training regimens.
Key words: psycho-motor training, variable priority, fixed priority, postural control, balance training

Introduction

Obesity is characterised by the excessive and abnormal accumulation of fat in the body [1], with body mass index (BMI) values of 25 kg/m^2 or higher in Asian populations as they typically have a higher proportion of body fat and BMI compared to Western population [2, 3]. It constitutes a significant public health challenge in the twenty-first century, as it increases the risk of developing numerous medical conditions including physical and neurocognitive impairments [4].

Higher BMI has been found to correspond to greater postural instability [5], which refers to an impaired ability to maintain a state of equilibrium in response to external or volitional perturbations of the postural control system [6].

Several possible pathways that explain how obesity affects postural control have been established. An important contributing aspect is the elevated ankle torque brought on by an anterior shift in the centre of mass, which modifies the dynamics of balance. Obesity has also been linked to increased motor command variability, which may have an impact on the accuracy and consistency of postural adjustments [7]. The diminished sensitivity of mechanoreceptors on the plantar surface, which hinders the body's capacity to recognise and react to minute variations in posture [8, 9], ultimately leads to impaired balance in obese individuals [10].

Furthermore, it appears that postural instability may occur during dual-task (DT) conditions when attentional demands are higher, especially among individuals with obesity, who often exhibit altered executive function, thereby increasing the fall risk [11]. Obesity has also been increasingly associated with detrimental neurocognitive consequences, such as diminished cognitive capacity, particularly in regard to frontal lobe executive functions [12]. Obesity impacts the central nervous system in a variety of ways, including molecular changes like insulin resistance, oxidative stress, hormone imbalance, and neuroinflammation, as well as structural alterations like brain atrophy [13].

Thus, this study addresses a critical gap in the literature by examining the efficacy of DT training, attentional prioritisation strategies, and their interaction with obesity-related executive dysfunction in improving postural stability. The findings have the potential to inform evidence-based interventions aimed at reducing fall risk and improving functional outcomes in this high-risk population.

Therefore, this study's primary objective is to investigate and compare the effects of DT training and single-task (ST) training on postural stability in adults with obesity. Additionally, we aim to evaluate the influence of fixed-priority and variable-priority DT interventions on postural stability and balance in obese individuals.

Subjects and methods

Design

The study was designed as a three-arm parallel group, randomised controlled trial. The study was carried out according to the recommendations of CONSORT guidelines for randomised studies (Figure 1).

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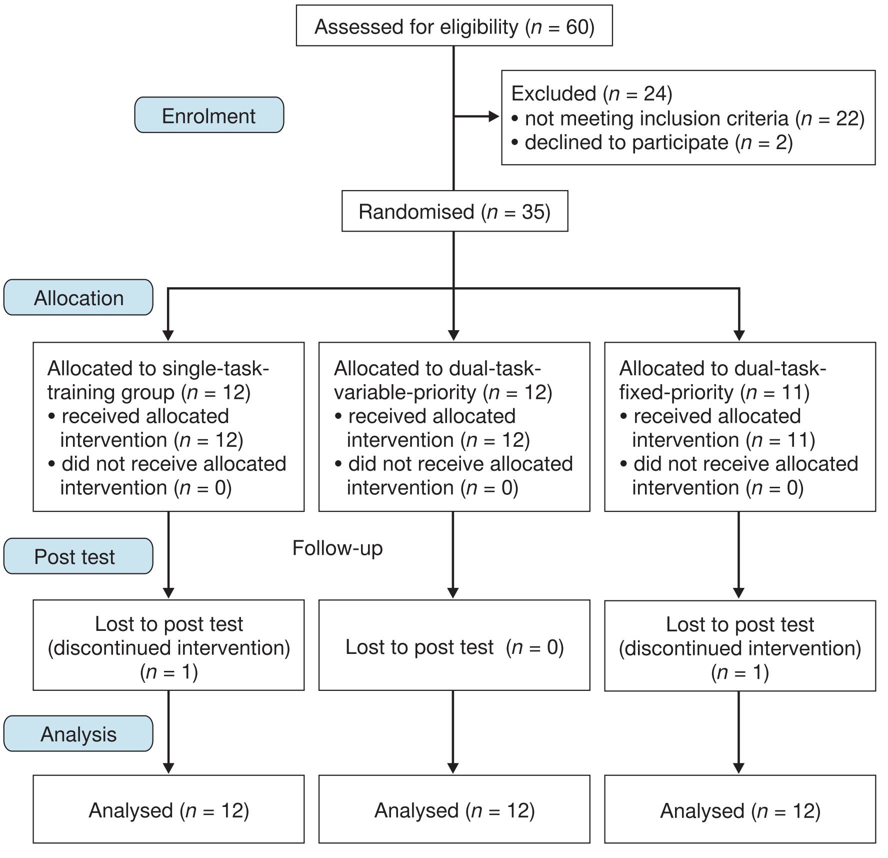


Figure 1. Consolidated standards of reporting trials (CONSORT) flow chart

Participants

Participants included in the study had a BMI ranging from 25 to 39.9 kg/m^2, were between 30 and 60 years of age, and had a waist–hip ratio of ≥ 0.85 in males and ≥ 0.80 in females. Inclusion criteria also required a unipedal stance test score ≤ 20 s on the dominant side, and the Mini Mental State Examination (MMSE) score > 24. Participants were excluded if they reported any neurological conditions such as stroke, multiple sclerosis or neuropathy, recent lower extremity injury/trauma/surgery in the past 6 months, lower extremity total joint replacement, uncorrected vision problems, inability to walk independently, uncontrolled diabetes, or known cardiovascular disease.

Sample size

The number of subjects for this study was determined using the G*Power 3.1 software, following statistical parameters derived from a previous study by [14]. The calculations were based on an effect size of 0.72, a significance alpha level of 0.05, and a statistical power (1-beta) of 0.80. The analysis indicated that a minimum of 29 participants would be required to achieve sufficient statistical power. However, to account for the possibility of participant dropout, which was estimated at 20%, the final sample size was increased to 35 to ensure the study's reliability and validity.

Randomisation and allocation

Block randomisation was implemented using the Sealed Envelope randomisation program (sealedenvelope.com) to ensure balanced allocation of participants across study groups. Allocation concealment was maintained throughout the randomisation process. Additionally, single-blinding was ensured by keeping participants unaware of the treatment they received.

Assessment and outcome measure

At baseline, height, weight, BMI, waist circumference, hip circumference, waist–hip ratio, and MMSE and unipedal stance test were recorded for the screening process. A calibrated stadiometer, weighing machine, and measuring tape were used to record the height, weight, and circumference, respectively. Evaluation was performed before and after the treatment for all variables. Primary outcome measurement included postural stability, measured through a Pedalo®-Sensamove balance device, and secondary outcome measures included Berg balance scale, TUG, TUG-Cog and unipedal stance test (UST).

Postural stability

Postural stability – This was evaluated using the Pedalo®-Sensamove balance device. It included CoP sway, CoP range, and reaction time. To measure the CoP sway (forward, backward, left and right), the subjects were asked to stand on the balance board while keeping their hands on their pelvis with their eyes open (EO) fixating their vision on the screen for 30 s, then in the eyes closed (EC) condition.

The CoP range was calculated by instructing the subjects to move in four different directions (forward, backward, left, and right) and to hold the position for 3 s in each direction, and the ranges were recorded.

Reaction time – Participants were instructed to stand on the balance board while a screen was placed in front of them. The objective for the participants was to touch the coloured spot on the screen as soon as it appeared, ensuring their centre of pressure (CoP) was aligned. The reaction time was determined as the duration taken for the participant to complete the task. The measurement of reaction time was conducted individually in four specific directions: forward, backward, right, and left [15].

TUG and TUG-Cog

TUG – the subjects were instructed to get out of a chair, walk three metres at a comfortable pace, turn around a cone, get back in the chair, and then sit down. The amount of time needed to finish the test was noted. TUG is a good indicator of physical performance in the obese population [16].

TUG-Cog – the subjects were instructed to get out of a chair, walk for three metres at a comfortable pace, turn around a cone, get back in the chair, and then sit down while counting backwards by threes from a random number between 20 and 100. The amount of time needed to finish the test was noted. TUG-Cog has good reliability in older adults, and the average time to perform TUG-Cog is 9.82 s for community-dwelling healthy older adults [17].

BBS

BBS measurements – the 14 items on the Berg balance scale assess functional movements such as sitting, standing, and changing positions that are often performed in daily life. Every task is graded on a five-point scale ranging from 0 to 4, with 56 being the highest possible score; lower scores indicate decreased stability.

UST

It was performed by instructing the subjects to stand barefoot while lifting the other limb so that the raised foot was close to but not touching the ankle of the stance limb. Each subject was instructed to focus on a point on the wall directly in front of them, crossing their arms over their chest before elevating their limb. A stopwatch was used to record the total time the subject could stand on one leg. The time began when the subject lifted their foot off the ground, and the end time was recorded when the subject used their arms, moved their weight-bearing foot, rotated it on the ground, opened their eyes on eyes-closed trials, or a maximum of 45 s had passed. This procedure was repeated three times and recorded on the data collection sheet. The average of the three trials was calculated, and subjects with a value less than 20 s were included in the study, as specified by [18].

After screening and baseline assessment, participants were randomly assigned to one of the three groups: DT fixed-priority (group 0), DT variable-priority (group 1) and the ST training group (group 2). A familiarisation session was given to all the participants to minimise errors in assessment. All the data were kept confidential.

Intervention

All the participants received 45-min sessions for 8 weeks, 3 days per week.

Group 0 – DT training – fixed-priority (FP) included a task involving primary balance or postural control activities along with secondary cognitive activities. Instructions were given to pay attention to both balance and cognitive tasks simultaneously.

Group 1 – DT training – variable-priority (VP) participants were instructed to perform the same set of activities as those of the FP group, but under a different instructional set. One half of the training focused on postural or balance activities, and the other half focused on cognitive tasks in a single session.

Group 2 – single-task training included only balance or postural control activities.

The training interventions are listed in Table 1.

Statistical analysis

Data analysis was performed using IBM SPSS version 29.0 (IBM Corp.). To check the normality of the distribution, the Shapiro–Wilk test was applied to all the variables. Log transformation was applied to those variables that were not normally distributed to decrease the uniformity of error. The one-way ANOVA was employed to contrast the baseline demographic characteristics among the intervention groups. A 3×2 mixed-model analysis of variance (ANOVA) were used to statistically analyse the effect on primary and secondary outcome measures with group (ST balance training, DT training with fixed-priority instructions, DT training with variable-priority instructions) as the between-subjects factor, and time (pre-training, post-training) and testing condition (ST testing, DT testing) as within-subject factors. Partial η^2 values were reported as measures of effect size. The level of statistical significance was set at $p < 0.05$. Where a significant group × time interaction effect was observed, post-hoc pairwise comparisons were conducted using the Bonferroni correction to control for multiple testing. The analysis was performed according to the intention-to-treat principle to preserve the benefits of the randomisation, and missing data were handled using the last observation carried forward (LOCF) method.

Results

Study selection and patient characteristics

Sixty subjects were assessed for eligibility. Out of these, 22 subjects did not meet the inclusion criteria and three refused to participate. Thirty-five subjects were selected to participate in the study and after randomisation were assigned to one of the three training groups. 12 each were allocated to the DT variable-priority group and the ST training group, whereas 11 participants were allocated to the DT fixed-priority group. Thirty-three subjects completed the training; one from the DT fixed-priority group and one from the ST training group refused to continue to participate in between the sessions. No adverse events associated with participation in the study were recorded. The CONSORT flow diagram is illustrated in Figure 1.

At the baseline assessment, no statistically significant differences were observed between the groups in terms of age, body weight, height, body mass index (BMI), waist circumference (W), hip circumference (H), or waist-to-hip ratio (W/H). The level of significance was $p > 0.05$ (Table 2).

Outcome analysis

All variables except reaction time front, showed a significant main effect of time on the primary outcome measures: CoP sway EO (forward, backward, left, right) ($p < 0.05$), CoP sway EC (forward, backward, left, right) ($p < 0.05$), CoP range (forward, backward, left, right) ($p < 0.05$), and reaction time (backward, left, right) ($p < 0.05$), and the secondary outcome measures: UPST (left, right) ($p < 0.01$); BBS ($p < 0.01$), TUG ($p < 0.01$), and TUG-Cog ($p < 0.01$). There was a significant difference ($p < 0.05$) in the interaction (group × time) effect of some parameters of CoP sway EO and EC, reaction time, and TUG-Cog ($p \leq 0.001$). However, no significant main effect of the group was observed for any of the variables (Tables 3 and 4).

Post-hoc pairwise comparisons with Bonferroni corrections indicated that the DT variable-priority group demon-

Table 1. Depicts training interventions

Week	Balance activity	Cognitive activity
1	Sit to stand Stand with feet shoulder-width apart, eyes open Stand with a narrow base of support (BOS), eyes open	Counting backward (e.g., by twos, threes): Subject counts backward randomly from any starting number and subtracts three each time
2	Stand with a narrow BOS, eyes closed Standing semi-tandem, eyes open while fixating on a target Sit to stand and walk	N-Back task: recite numbers, days, or months backward (December to January) Tell a story: tell any story, such as what they did in the morning, what they did on their vacation, and so on
3	Standing semi-tandem, eyes closed Stand on foam, eyes open and closed Stand and step forward, backward, and sideways	Random digit generation: randomly name the numbers between 0 and 500 Subtract or add a number to a letter: give the letter resulting from the equation (e.g., K – 1 = J)
4	Walk on a straight line Stand with a narrow BOS and reach in different directions Sit to stand and pick up an object from the floor	Spell a word backward: Spell a word backward such as ‘apple’, ‘bird’, or ‘television’ Subtract or add a number to a letter: give the letter resulting from the equation (e.g., K – 1 = J)
5	Sit to stand and stop with varied speeds Stand with a narrow BOS and reach in different directions Walk with a narrow BOS	Stroop task: Name the colour of the ink while ignoring the meaning of the word Visual discrimination tasks: pictures are presented before and after performing the balance tasks, which they have to memorise then answer if the pictures are the same. Say ‘yes’ if the pictures are same, and ‘no’ if they are different
6	Walk with a narrow BOS holding an object Walk around obstacles Stand and move with hips in abduction and adduction Stand with stepping forward, backward, and sideways	Remembering things: memorise telephone numbers, prices, objects, or words Visual imaginary spatial task: imagine and name the road direction (e.g., the road direction from their home to the park)
7	Sit on a ball and perturb Stand and move the hip and knee in flexion and extension Walk and kick a ball Throw a ball	Spell a word backward: spell a word backward such as ‘apple’, ‘bird’, or ‘television’ Random digit generation: randomly name the numbers between 0 and 500
8	Tandem walking Sit to stand on different chair heights Walk with a narrow BOS Walk and kick a ball	Visual discrimination tasks: pictures are presented before and after performing the balance tasks, which they have to memorise then answer if the pictures are the same. Say ‘yes’ if the pictures are same, and ‘no’ if they are different Spell a word backward: spell a word backward such as ‘apple’, ‘bird’, or ‘television’

BOS – base of support

Table 2. Demographic characteristics

Variable	Group 0 (*n* = 11) mean ± *SD*	Group 1 (*n* = 12) mean ± *SD*	Group 2 (*n* = 12) mean ± *SD*	*p*-value
Age	43 ± 8.53	49.92 ± 9.64	46.1 ± 7.92	0.184
Height (cm)	157.74 ± 9.41	158.23 ± 9.52	155.64 ± 9.17	0.797
Weight (kg)	77.59 ± 12.54	82.2 ± 17.5	78.55 ± 7.16	0.688
BMI	31.27 ± 3.01	32.61 ± 4.01	32.59 ± 3.62	0.612
Waist circumference (cm)	100 ± 9.2	106.9 ± 10.82	106.24 ± 5.67	0.155
Hip circumference (cm)	105.8 ± 9.38	108.9 ± 8.16	111.69 ± 6.73	0.274
W/H ratio	0.94 ± 0.05	0.99 ± 0.09	0.94 ± 0.05	0.151

BMI – body mass index, W – waist circumference, H – hip circumference

Table 3. Primary outcome measure values of 3 × 2 mixed model ANOVA

Measure	Source	*F*-value	*p*-value	η^2
CoP sway forward (EO) (°)	time	24.2	< 0.01*	0.44
	group × time	4.35	0.02*	0.22
	group	1.28	0.29	0.079
CoP sway backward (EO) (°)	time	5.97	0.021*	0.16
	group × time	0.79	0.49	0.046
	group	1.02	0.373	0.064
CoP sway left (EO) (°)	time	7.6	0.01*	0.203
	group × time	0.68	0.513	0.044
	group	0.20	0.813	0.014
CoP sway right (EO) (°)	time	408.57	< 0.01*	0.93
	group × time	0.20	0.81	0.014
	group	0.15	0.85	0.01
CoP sway forward (EC) (°)	time	11.5	0.002*	0.28
	group × time	1.49	0.24	0.094
	group	0.46	0.63	0.031
CoP sway backward (EC) (°)	time	17.8	< 0.01*	0.37
	group × time	4.29	0.023*	0.22
	group	0.86	0.43	0.05
CoP sway left (EC) (°)	time	22.05	< 0.01*	0.42
	group × time	0.66	0.52	0.04
	group	0.34	0.71	0.02
CoP sway right (EC) (°)	time	6.58	0.016*	0.18
	group × time	4.59	0.018*	0.23
	group	2.01	0.15	0.119
CoP range forward (°)	time	26.6	< 0.01*	0.47
	group × time	1.01	0.37	0.06
	group	1.2	0.31	0.074
CoP range backward (°)	time	11.17	0.002*	0.27
	group × time	2.32	0.115	0.13
	group	0.69	0.5	0.04
CoP range left (°)	time	6.16	0.019*	0.17
	group × time	0.157	0.85	0.01
	group	0.70	0.5	0.45
CoP range right (°)	time	17.17	< 0.001*	0.36
	group × time	1.21	0.32	0.075
	group	0.61	0.54	0.039
Reaction time forward (s)	time	2.23	0.14	0.069
	group × time	0.75	0.47	0.048
	group	0.17	0.84	0.012
Reaction time backward (s)	time	4.41	0.04*	0.12
	group × time	1.77	0.18	0.10
	group	0.87	0.43	0.05
Reaction time left (s)	time	5.53	0.025*	0.156
	group × time	3.8	0.034*	0.203
	group	2.84	0.074	0.16
Reaction time right (s)	time	3.92	0.05*	0.11
	group × time	0.23	0.792	0.015
	group	0.045	0.95	0.003

CoP – centre of pressure, EO – eyes open, EC – eyes closed
* signifies a statistically significant difference, i.e., $p < 0.05$

Table 4. Secondary outcome measure values of 3 × 2 mixed model ANOVA

Measure	Source	*F*-value	*p*-value	η^2
UPST (R)	time	199.69	< 0.01*	0.869
	group × time	1.045	0.364	0.065
	group	0.745	0.483	0.047
UPST (L)	time	140.7	< 0.01*	0.824
	group × time	0.225	0.80	0.015
	group	0.203	0.817	0.013
BBS	time	127.5	< 0.01*	0.81
	group × time	2.23	0.124	0.13
	group	0.27	0.76	0.018
TUG	time	157.8	< 0.01*	0.84
	group × time	3.04	0.06	0.169
	group	0.16	0.85	0.011
TUG-Cog	time	131.3	< 0.01*	0.814
	group × time	34.6	< 0.01*	0.69
	group	1.60	0.2	0.097

UPST (R) – unipedal stance test right, UPST (L) – unipedal stance test left, BBS – Berg balance scale, TUG – timed up and go test, TUG-Cog – timed up and go test cognitive
* signifies a statistically significant difference, i.e., $p < 0.05$

strated significantly greater improvements in the CoP sway and TUG-Cog parameters compared to the DT fixed-priority group ($p < 0.05$), while no significant differences were observed between the ST training group and the other groups (Figure 2–6).

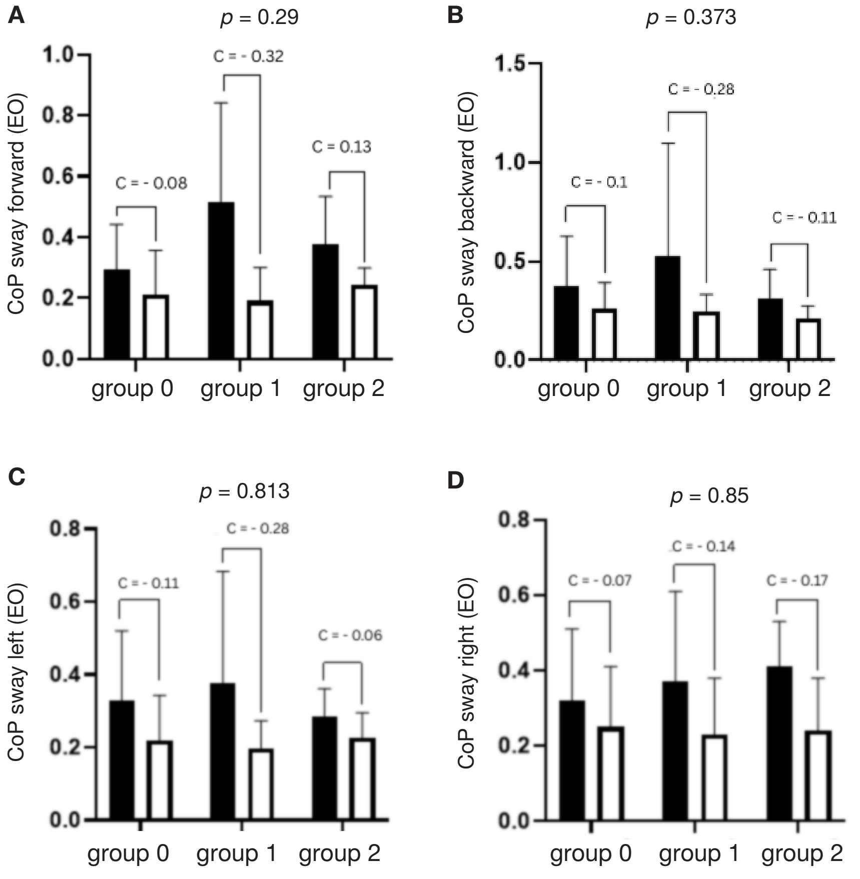
Discussion

The primary aim of this investigation was to evaluate the influence of motor-cognitive dual-task (DT) training on postural stability parameters, such as CoP sway in both eyes open and closed conditions, CoP range, reaction time, and clinical tests for balance assessment, including the unipedal stance test, BBS, TUG test, and TUG-Cog test, in obese individuals. This study also aimed to identify any statistically significant differences between the DT and ST training groups and between the DT variable-priority and fixed-priority groups.

Effect of dual-task training

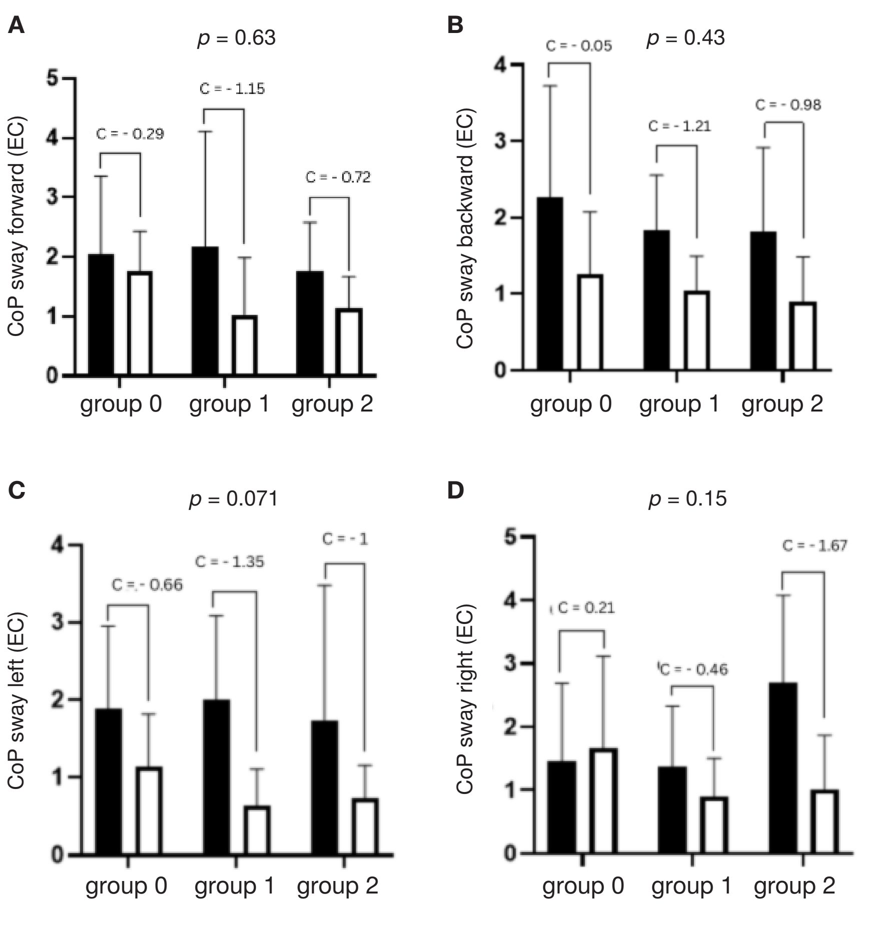
The present study demonstrated pronounced effects of dual-task training on balance parameters, including the UPST, BBS, TUG, and TUG-Cog tests in obese individuals after receiving 8 weeks of training intervention, which was in line with the study [19], which stated that significant improvement in balance is due to the synergistic effects of the motor and cognitive tasks in dual-task training. This synergy likely results from enhanced neuroplasticity driven by combining cognitive and physical challenges [20]. Integrating cognitive tasks with physical activities demands processing multiple information streams, which may improve attentional resource allocation and response to balance tasks [21].

As hypothesised, motor-cognitive DT training was effective in improving postural stability parameters, including CoP range, reaction time, and CoP sway in both eyes open and closed conditions. Radiological evidence using Functional



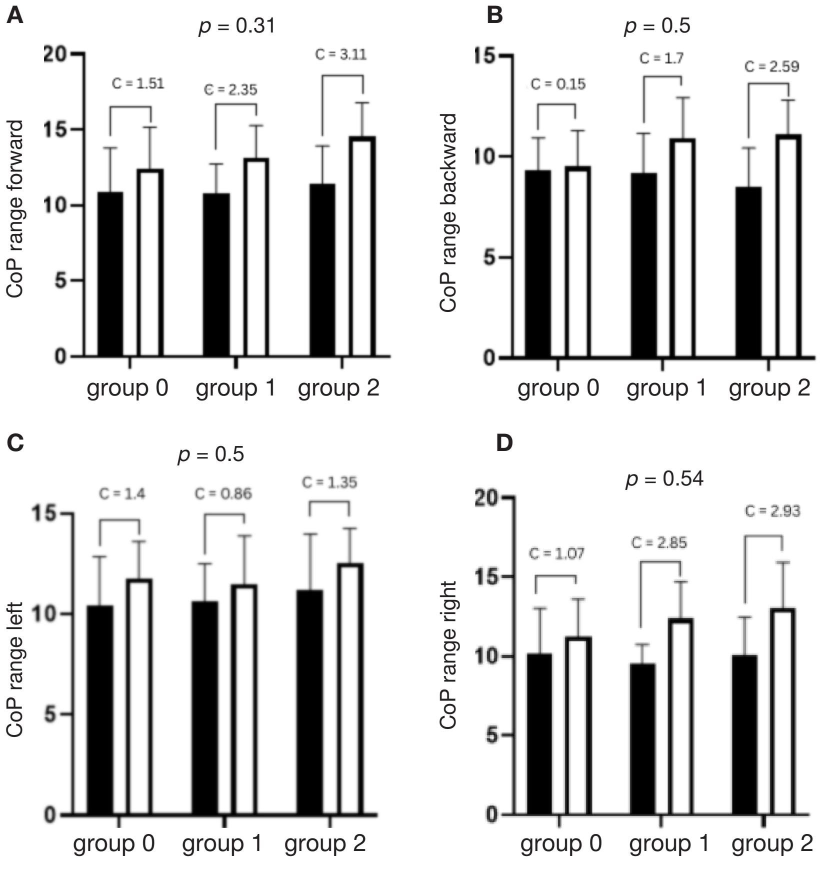
C – change (pre-mean–post-mean)
CoP – centre of pressure
EO – eyes open

Figure 2. Between-group change in means pre- and post-intervention:
(A) CoP sway forward (EO)
(B) CoP sway backward (EO)
(C) CoP sway left (EO)
(D) CoP sway right (EO)



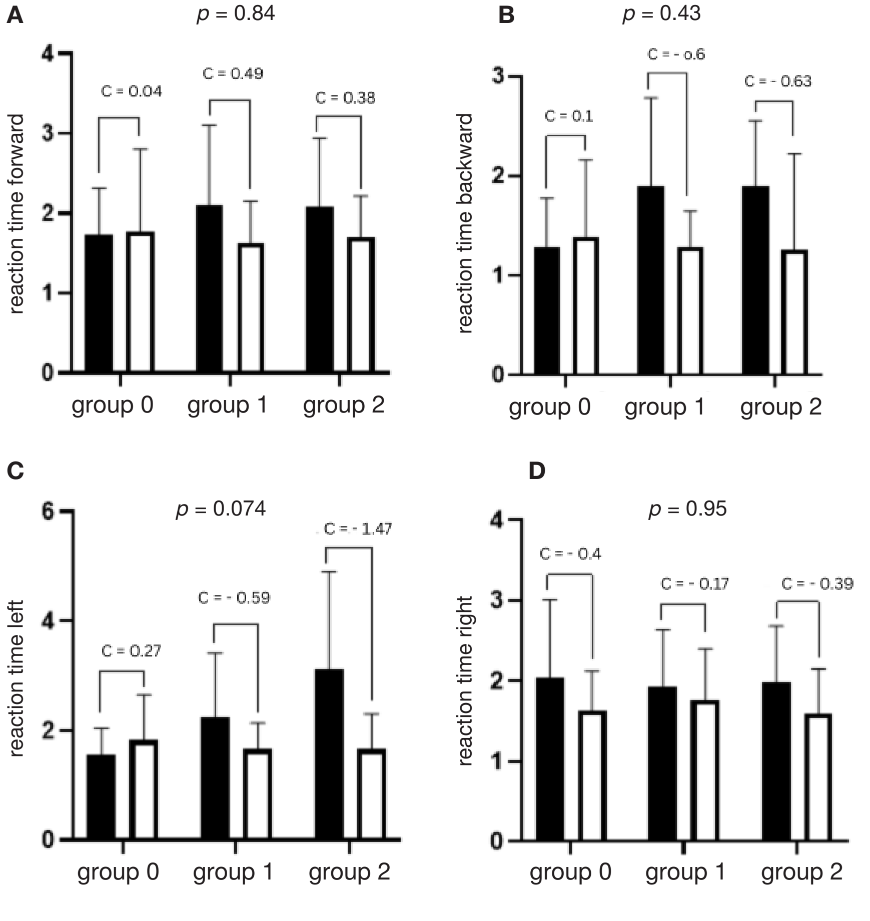
C – change (pre-mean–post-mean)
CoP – centre of pressure
EC – eyes closed

Figure 3. Between-groups change in means pre- and post-intervention:
(A) CoP sway forward (EC)
(B) CoP sway backward (EC)
(C) CoP sway left (EC)
(D) CoP sway right (EC)



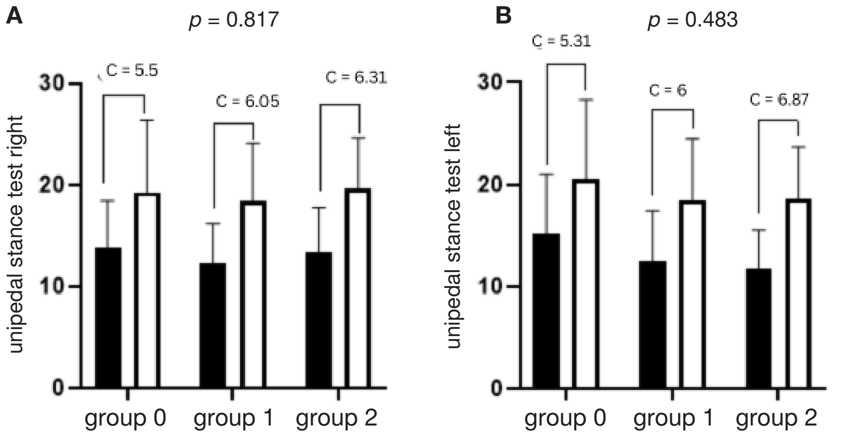
pre
post
C – change (pre-mean–post-mean)
CoP – centre of pressure

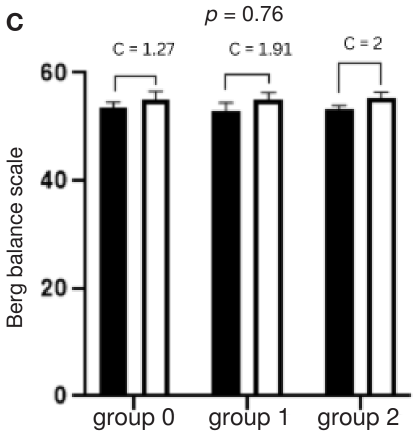
Figure 4. Between-groups change in means pre- and post-intervention:
(A) CoP range forward
(B) CoP range backward
(C) CoP range left
(D) CoP range right



pre
post
C – change (pre-mean–post-mean)

Figure 5. Between-groups change in means pre- and post-intervention:
(A) reaction time forward
(B) reaction time backward
(C) reaction time left
(D) reaction time right





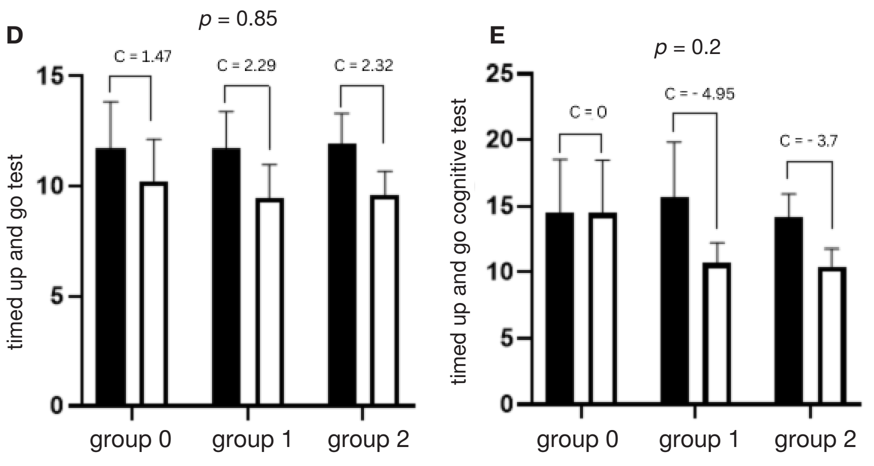
p = 0.95

pre

post

C – change (pre-mean–post-mean)

Figure 6. Between-groups change in means pre- and post-intervention:
(A) unipedal stance test right
(B) unipedal stance test left
(C) Berg balance scale
(D) timed up and go test
(E) timed up and go cognitive test



Magnetic Resonance Imaging (fMRI) in the study [22] suggests that there is enhanced cerebral haemodynamics in the dorsolateral prefrontal cortex within the DT training group, while certain centres of the brain associated with DT processing showed less activation post-training, implying reduced processing demands and hence improved postural control, resulting in reduced muscle coactivation and muscle guarding, which leads to decrements in postural sway. These findings are in line with the previous studies [14, 23–31].

Dual-task vs. single-task training

The non-significant results between the DT and ST groups can be explained by the supporting task automation hypothesis. It states that concentrating on a single task at a time enables participants to automate their performance of individual tasks. This leads to a reduction in the processing demands required to perform the task, ultimately resulting in quicker development and acquisition of skills in both the ST and DT training groups [14, 30, 31]. The study [14] found no significant difference between DT variable-priority and fixed-priority groups post eight weeks of intervention, which is in line with the results of this study. These findings were also in line with the study [21], where non-significant results were noted between DT and ST training groups in patients with multiple sclerosis. The non-significant differences could also be attributed to the small sample size, lack of follow-up assessment, and the inclusion of healthy and active individuals in this study.

The alignment between these studies signifies a consistent trend across different populations and interventions. It suggests that, in certain contexts, the distinction between DT variable-priority and fixed-priority interventions may not yield significant differences in outcomes over the specified intervention period. This observation prompts further exploration into the underlying mechanisms at play and underscores the importance of considering various factors, such as population characteristics and intervention protocols, when interpreting study outcomes and designing future research endeavours. While the absence of significant differences between the DT intervention groups may appear to challenge prevailing assumptions about the benefits of attentional prioritisation strategies, it also highlights the complexity of these interactions and the need for nuanced approaches in rehabilitation and therapeutic interventions.

Dual-task variable priority vs. dual-task fixed priority

Though, non-significant results were observed in the DT variable-priority group and fixed-priority groups, greater improvement in terms of change in the mean from pre to post was seen in the DT variable-priority group among the CoP sway and TUG-Cog measures. These findings are similar to the studies [14, 31, 32], suggesting that a variable-priority instruction set in DT training shows greater improvement of balance and DT walking speed because of decreased processing demands when attention shifts between cognitive and balance activities.

However, the study [33] did not show any significant difference between the DT group with variable-priority instructions and with variable-priority progressing to fixed-priority instructions on balance, TUG-Cog, gait speed, or cognition. They cited the lack of task specificity in the protocol in order to obtain significant between-group differences as the reason.

These inconsistent findings necessitate future studies that delve deeper into elucidating the specific circumstances under which DT interventions, with varying attentional priorities, might yield differential effects on functional outcomes. Additionally, exploring potential moderators or mediators of treatment response, such as baseline cognitive function or motor impairment severity, could provide valuable insights into optimising intervention strategies tailored to individual needs and characteristics. Overall, these findings underscore the importance of continued research efforts aimed at refining and personalising rehabilitation approaches to maximise postural stability demands for obese individuals.

Limitations

There are several limitations to the study. Firstly, the small sample size restricts the generalisability of the findings and diminishes the statistical power to detect significant differences between the groups. Secondly, the predominantly female composition of our sample, consisting of relatively healthy and physically fit individuals with only mild balance impairment, hampers the extrapolation of results to male participants and those with moderate through severe balance deficits. Thirdly, the absence of a follow-up period undermines the ability to assess the longer-term effects, particularly within the two DT training groups. Future research endeavours would necessitate a larger sample size to ascertain whether clinically relevant discrepancies exist with DT training across different cohorts. Additionally, a follow-up period would be indispensable to elucidate variances between the DT variable-priority and fixed-priority groups, and to gauge the retention of training effects over time. This longitudinal perspective is crucial for understanding the sustainability of the observed improvements and informing recommendations for long-term rehabilitation and maintenance programs.

Conclusions

Following an 8-week dual-task (DT) training program that included both variable and fixed-priority instructional sets, this study demonstrates notable gains in postural stability and balance among obese individuals. Nevertheless, no benefit was observed between the variable and fixed-priority sets, and the intervention was not better than conventional single-task training. The lack of superiority over single-task training necessitates more research into the mechanisms underlying these benefits, even though these results provide insights into how well DT training improves postural stability. Furthermore, the lack of obvious advantages between fixed and variable-priority prompts the question of how best to allocate attentional resources. To find out if there are any clinically meaningful differences between these methods, more extensive studies are required.

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Ethical approval

The research related to human use complied with all the relevant national regulations and institutional policies, followed the tenets of the Declaration of Helsinki, and was approved by Institutional Ethical Committee, Jamia Millia Islamia (approval No.: 12/10/406/IEC/JMI/2022) and registered in the Clinical Trial Registry India (trial number-CTRI/2023/04/051245).

Informed consent

Informed consent was obtained from all individuals included in this study.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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References

[1] Chandrasekaran P, Weiskirchen R. The role of obesity in type 2 diabetes mellitus – an overview. Int J Molecular Sci. 2024;25(3):1882; doi: 10.3390/ijms25031882.
[2] Pan W-H, Yeh W-T. How to define obesity? Evidence-based multiple action points for public awareness, screening, and treatment: an extension of Asian-Pacific recommendations. Asia Pac J Clin Nutr. 2008;17(3):370–4.
[3] 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; doi: 10.1089/dia.2015.0007.
[4] Prickett C, Brennan L, Stolwyk R. Examining the relationship between obesity and cognitive function: a systematic literature review. Obes Re Clin Pract.2015;9(2):93–113; doi: 10.1016/j.orcp.2014.05.001.
[5] Meng H, Gorniak SL. Effects of adiposity on postural control and cognition in older adults. Gait Posture. 2020;82:147–52; doi: 10.1016/j.gaitpost.2020.09.004.
[6] Prieto TE, Myklebust JB, Myklebust BM. Characterization and modeling of postural steadiness in the elderly:

a review. IEEE Transactions on rehabilitation engineering. 2002;1(1):26–34; doi: 10.1109/86.242405.
[7] Simoneau M, Teasdale N. Balance control impairment in obese individuals is caused by larger balance motor commands variability. Gait Posture. 2015;41(1):203–8; doi: 10.1016/j.gaitpost.2014.10.008.
[8] Teasdale N, Simoneau M, Corbeil P, Handrigan G, Tremblay A, Hue O. Obesity alters balance and movement control. Curr Obes Rep. 2013;2:235–40; doi: 10.1007/s13679-013-0057-8.
[9] Wu X, Madigan ML. Impaired plantar sensitivity among the obese is associated with increased postural sway. Neurosci Lett. 2014;583:49–54; doi: 10.1016/j.neulet.2014.09.029.
[10] Son SM. Influence of obesity on postural stability in young adults. Osong Public Health Res Perspect. 2016;7(6):378–81; doi: 10.1016/j.phrp.2016.10.001.
[11] Small GH, Brough LG, Neptune RR. The influence of cognitive load on balance control during steady-state walking. J Biomech. 2021;122:110466; doi: 10.1016/j.jbiomech.2021.110466.
[12] Elias MF, Elias PK, Sullivan LM, Wolf PA, D'Agostino RB. Lower cognitive function in the presence of obesity and hypertension: the Framingham heart study. Int J Obes Relat Metab Disord. 2003;27(2):260–8; doi: 10.1038/sj.ijo.802225.
[13] Da Conceicao ARR, Vieira MNN, De Felice FG. Structural changes in the obese brain. Neural Regen Res. 2024;19(12):2561–2; doi: 10.4103/NRR.NRR-D-23-01123.
[14] Silsupadol P, Lugade V, Shumway-Cook A, van Donkelaar P, Chou LS, Mayr U, Woollacott MH. Training-related changes in dual-task walking performance of elderly persons with balance impairment: a double-blind, randomized controlled trial. Gait Posture. 2009;29(4):634–9; doi: 10.1016/j.gaitpost.2009.01.006.
[15] Noohu MM, Moiz JA, Dey AB, Hussain ME. A balance device reliability for reaction time and proprioception measurement in older adults. Indian J Gerontol. 2016;30(3):396–403.
[16] Pasco JA, Sui SX, Tembo MC, Holloway-Kew KL, Rufus PG, Kotowicz MA. Sarcopenic obesity and falls in the elderly. J Gerontol Geriatr Res. 2018;7(2); doi: 10.4172/2167-7182.1000465.
[17] Hofheinz M, Schusterschitz C. Dual task interference in estimating the risk of falls and measuring change: a comparative, psychometric study of four measurements. Clin Rehabil. 2010;24(9):831–42; doi: 10.1177/0269215510367993.
[18] Springer BA, Marin R, Cyhan T, Roberts H, Gill NW. Normative values for the unipedal stance test with eyes open and closed. J Geriatr Phys Ther. 2007;30(1):8–15; doi: 10.1519/00139143-200704000-00003.
[19] Wang Y, Zhang C, Wang B, Zhang D, Song X. Comparative effects of cognitive and instability resistance training versus instability resistance training on balance and cognition in elderly women. Sci Rep. 2024;14(1):26045; doi: 10.1038/s41598-024-77536-x.
[20] Bamidis PD, Vivas AB, Styliadis C, Frantzidis C, Klados M, Schlee W, Siountas A, Papageorgiou SG. A review of physical and cognitive interventions in aging. Neurosci Biobehav Rev. 2014;44:206–20; doi: 10.1016/j.neubiorev.2014.03.019.
[21] Fraser SA, Li KZ-H, Berryman N, Desjardins-Crépeau L, Lussier M, Vadaga K, Lehr L, Vu TTM, Bosquet L, Bherer L. Does combined physical and cognitive training improve dual-task balance and gait outcomes in sedentary older adults?. Front Hum Neurosci. 2017;10; doi: 10.3389/fnhum.2016.00688.
[22] Erickson KI, Colcombe SJ, Wadhwa R, Bherer L, Peterson MS, Scalf PE, Kim JS, Alvarado M, Kramer AF. Training-induced functional activation changes in dual-task processing: an fMRI study. Cerebral Cortex. 2007;17(1):192–204; doi: 10.1093/cercor/bhj137.
[23] Rezaie S, Goharpey S, Ghanavati T, Yadollah Poor N, Moradi L, Zade MHH. Effect of cognitive dual-task training on postural stability in older adults with diabetic peripheral neuropathy: a randomized control trial. J Biochem Tech. 2020;Spec Issue 1:127–33.
[24] Choi JH, Kim BR, Han EY, Kim SM. The effect of dual-task training on balance and cognition in patients with subacute post-stroke. Ann Rehabil Med. 2015;39(1):81–90; doi: 10.5535/arm.2015.39.1.81.
[25] Elhinidi EI, Ismaeel MM, El-Saeed TM. Effect of dual-task training on postural stability in children with infantile hemiparesis. J Phys Ther Sci. 2016;28(3):875–80; doi: 10.1589/jpts.28.875.
[26] An H-J, Kim J-I, Kim Y-R, Lee K-B, Kim D-J, Yoo K-T, Choi J-H. The effect of various dual task training methods with gait on the balance and gait of patients with chronic stroke. J Phys Ther Sci. 2014;26(8):1287–9; doi: 10.1589/jpts.26.1287.
[27] Kim D, Ko J, Woo Y. Effects of dual task training with visual restriction and an unstable base on the balance and attention of stroke patients. J Phys Ther Sci. 2013;25(12):1579–82; doi: 10.1589/jpts.25.1579.
[28] Hyndman D, Ashburn A, Yardley L, Stack E. Interference between balance, gait and cognitive task performance among people with stroke living in the community. Disabil Rehabil. 2006;28(13–14):849–56; doi: 10.1080/09638280500534994.
[29] Pellecchia GL. Dual-task training reduces impact of cognitive task on postural sway. J Mot Behav. 2005;37(3):239–46; doi: 10.3200/JMBR.37.3.239-246.
[30] Ruthruff E, Van Selst M, Johnston JC, Remington R. How does practice reduce dual-task interference: integration, automatization, or just stage-shortening?. Psychol Res. 2006;70(2):125–42; doi: 10.1007/s00426-004-0192-7.
[31] Kramer AF, Larish JF, Strayer DL. Training for attentional control in dual task settings: a comparison of young and old adults. J Exp Psychol Appl. 1995;1(1):50–76; doi: 10.1037/1076-898X.1.1.50.
[32] Buragadda S, Alyaemni A, Melam GR, Alghamdi MA. Effect of dual-task training (fixed priority-versus-variable priority) for improving balance in older adults. World Appl Sci J. 2012;20(6):884–8.
[33] Trombini-Souza F, de Moura VTG, da Silva LWN, dos Santos Leal IDS, Nascimento CA, Silva PST, Perracini MR, Sacco IC, de Araújo RC, Nascimento MM. Effects of two different dual-task training protocols on gait, balance, and cognitive function in community-dwelling older adults: a 24-week randomized controlled trial. PeerJ. 2023;11:e15030; doi: 10.7717/peerj.15030.

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