Effect Of Whole Body Vibration on Depression, Anxiety, Stress and Quality of Life in Collegiate Students: A Randomized Controlled Trial

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Abstract

Objective: To determine the effects of whole-body vibration (WBV) training on depression, anxiety, stress and quality of life (QoL) in collegiate students. ***Methods:*** A total of 30 college students with a mean age of 24.1 ± 1.29 (years) were included in the study. The students were recruited if they are non-athlete, are not involved in any routine exercises, and the depression, anxiety, stress score (DASS) is not normal. Participants were excluded if they received medication for mental disorders, had any lower limb prosthesis, history of fracture, or any neurological disorder (like neuropathy or seizures). Subjects were randomly allocated to either the exercise group (n=15) or the WBV group (n=15). The DASS and Short Form 36 (SF-36) pre and post-scores were measured and compared. ***Results:*** Depression ($p < 0.001$), anxiety ($p < 0.001$) and stress ($p < 0.001$) were found to be significant for within-group effects. There was a significant improvement in all the components SF-36 within-group and role limitation due to emotional problems between interaction effect ($p< 0.04$). ***Conclusion:*** WBV effectively reduces depression, anxiety, and stress and improves QoL in young collegiate.

Keywords: Whole body vibration, Depression, Mental health, Quality of life, Exercise, Collegiate.

Introduction

Students face different types of stress, which causes academic pressure, persistent pressure to win, rivalry with peers, lack of leisure time and less free time with their parents. In addition, they are worried about the future and have financial troubles in some parts of the globe (1). Stress was described as the multi-system response of the body to any threat that overwhelms or is considered likely to overwhelm selective homeostatic reaction mechanisms (2). According to the American Association of Anxiety and Depression, 7 out of 10 adults in the US claim to have stress daily at least from mild to moderate level. While stress is an unfortunate fact of life, it is widespread among students at the university and becomes more prevalent (3). Due to its biological, emotional and psychological impacts, it has been confirmed by the World Health Organization (WHO) as the principal cause of disability. Depressed students may feel intense depression, exhaustion, remorse, and despair. It is common among college students and is experienced by 1 in 7 students (4). Depression has been reported to affect over 340 million people worldwide (5), which is associated with anxiety (6).

Modern lifestyle features increased stress, depression and anxiety (7). Researchers are seeking non-pharmacological and noninvasive treatment for these diseases due to adverse effects and, in some cases, inefficacy in their treatment (8). Complementary and alternative treatment systems can be used as a 1st line treatment for less severe depression (9). Exercise is an affordable, low-cost, non-pharmacological treatment for depression (10).

The training on WBV has lately been adopted as an additional type of workout or as a kind of physical activity in health and wellness centers. WBV training has a beneficial effect on depressive levels in normal individuals (11). The role of most antidepressant medications is to produce more serotonin accessible to bind on the cell receptor sites. Former studies have found out that serotonin increases after exercise; it has been verified by directly measuring the central serotonin level in animals. Exercise thus has an antidepressant-like role by releasing more serotonin. The outcomes of exercise on blood serotonin concentrations are close to antidepressants (12).

In subjects with severe depression, hypercortisolemia is almost exclusively (13). After the WBV treatment, cortisol levels decreased significantly in subjects, and it also induced increased concentration of blood testosterone and growth hormone level (14). The impact of

physical exercise on depressive symptoms in healthy individuals (i.e., those who rate normal range for depressive symptoms) has received limited recognition (10). Therefore, this study aims to find the impact of WBV training as an external exercise method to enhance psychosocial factors in collegiate students.

Methods

Participants

A total of 50 students were checked for eligibility on DASS (Depression >10, Anxiety >8, Stress > 15) from Jamia Millia Islamia. Eight students did not fulfill the criteria, and 12 students declined to participate due to their schedule. Thirty students were included in the study. Exclusion criteria are participants involved in any routine exercises, taking medication for mental health, having any lower limb prosthesis, history of any bony injury like a fracture, neurological disorders like neuropathy or seizures. The mean age and BMI of the participants are 24.1 ± 1.29 years and 21.59 ± 3.44 kg/m^2, respectively. Demographic details of the participants are shown in Table 1. Ethical clearance was taken from the Institutional Ethical Committee (IEC), Jamia Millia Islamia (a Central University), with reference no.: 26/11/263/JMI/IEC/2019. After the recruitment, written informed consent was taken from each participant. The allocation of the participants was done by computer randomization method, and the participants were blinded and allocated to either of the two equal groups: WBV group (n=15) or exercise group (n=15) (Fig 1).

Table 1: Comparison of demographic characteristics and outcome variables at baseline

Outcome measures	**Exercise Group (n=15) Mean ± SD**	**WBV group (n=15) Mean ± SD**	**Independent t-test or Mann-Whitney U test (p-value)**
Age (year)	24 ± 1.25	24.33 ± 1.35	-
Gender (Male/Female)	6/9	3/12	-
Height (cm)	165.86 ± 8.97	160.6 ± 9.85	-
Weight (kg)	60 ± 11.41	56 ± 14.71	-
BMI (kg/m^2)	21.66 ± 2.97	21.52 ± 3.96	-
DASS			
Depression	19.47 ± 9.15	15.93 ± 6.6	0.23
Anxiety	15.5 ± 7.32	12.13 ± 5.60	0.17
Stress	23.40 ± 7.84	20.7 ± 6.22	0.31
SF-36			
General Health	55.27 ± 22.63	56.11 ± 18.49	0.91
Physical Functioning	83 ± 12.51	70.67 ± 17.71	0.03*
Role Limitation due to Physical Health	58.33 ± 36.19	25 ± 31.34	0.01*

Role Limitation due to Emotional Problems	37.77 ± 30.51	15.55 ± 30.51	0.03*
Social Functioning	55 ± 23.05	59.17 ± 12.01	0.54
Pain	67 ± 21.84	55.67 ± 21.1	0.16
Energy/Fatigue	47.33 ± 16.99	44.67 ± 12.17	0.625
Emotional Well Being	49.87 ± 19.82	54.13 ± 14.49	0.51

WBV: Whole body vibration; BMI: Body mass index; DASS: Depression anxiety stress score; SF-36: Short form 36; *: significant difference between the groups.

Study chart

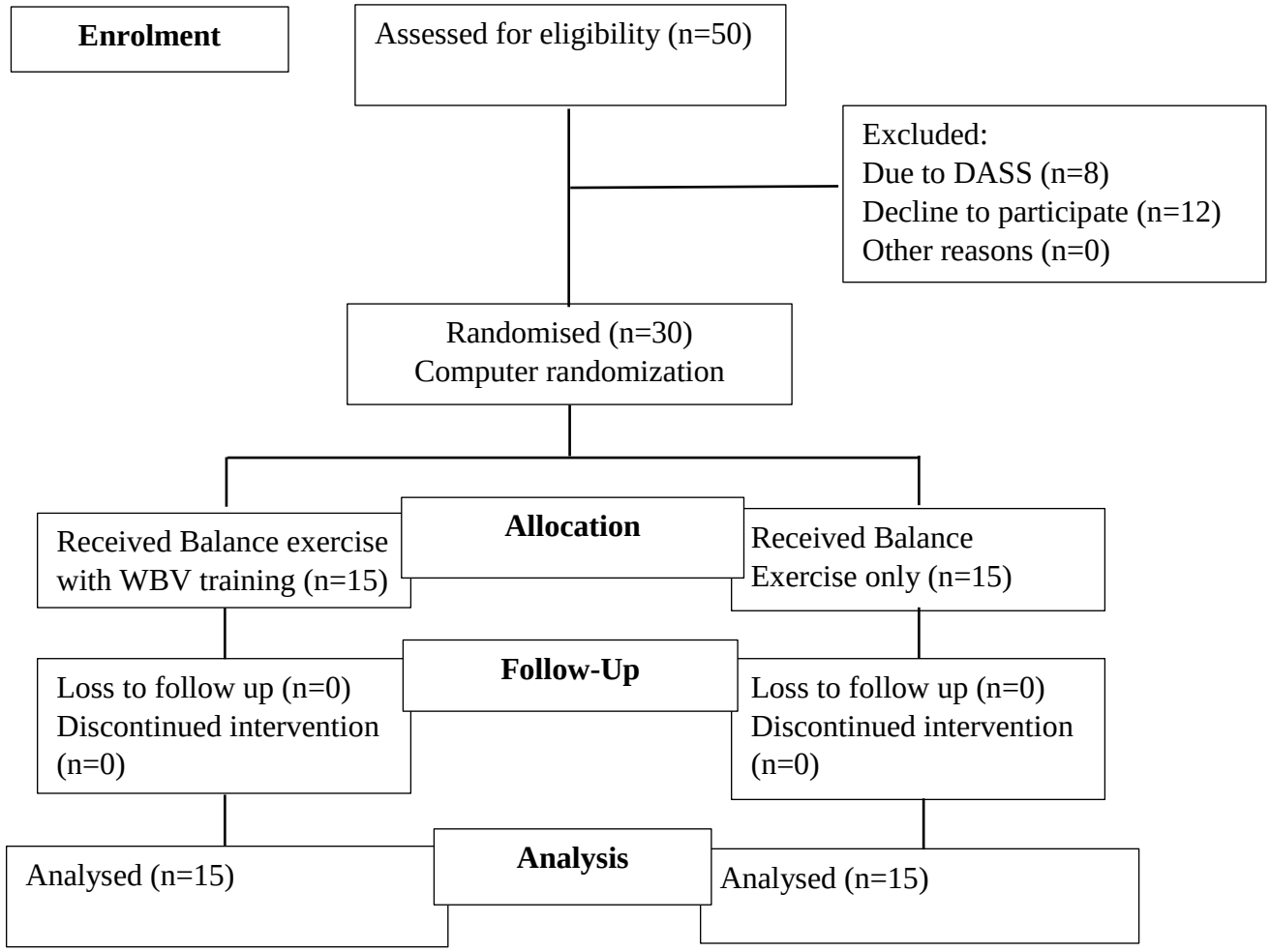

Figure 1: Flow chart of the study

Procedure

Baseline measurements of DASS and SF-36 were taken for all the participants. A familiarization session was given after the randomization. The warm-up session includes 5 minutes of jogging and stretching the lower limb muscles. The participants in the WBV group

performed exercises on the vibration platform, and participants in the exercise group performed without vibration. At the end of each session, a cool-down period was given, including a self-paced slow walk for at least 5 minutes. The duration of the intervention was four weeks, two sessions per week, after which the DASS and the SF-36 scoring were done for each participant.

Intervention

Participants in the WBV group performed a) static squat at 100° of knee flexion b) dynamic squat between 90 and 130° knee flexion for every single leg c) dynamic squat from 90° to 130° of knee flexion for both legs d) squat at 100° of knee flexion shifting body weight from one leg to another on the vibrating platform. Participants have to maintain the squat position for 30 secs with 30 secs rest between each squat. Three sets of each exercise with 3 mins rest was done between each set. Vibration is set at a frequency of 30hz with 2 mm amplitude. In the exercise group, participants perform the same set of exercises on the leveled surface without vibration.

The model of the vibration unit is Whole Body Vibrating Platform KH 75 manufactured by Crazy Fit VIVA fitness, India. The unit has a rectangular platform with supporting bars for holding with both hands. The platform produces vibrations, and the intensity is chosen based on previous literature. The frequency is decided to be 30 Hz because a frequency lower than 20 Hz may evoke muscular relaxation, and frequency ≥50 Hz may cause muscle soreness and unpleasant sensations. The participants hold the supporting bars as long as they stand on the platform.

Outcome measures

DASS

The DASS is a 42-item summary of three self-reporting interventions measuring the negative emotional symptoms of depression, anxiety & stress. The scale consists of 14 items, separated into two to five subscales of similar content. Respondents use a 4 - point intensity scale to measure the degree to which they have undergone each illness during the past week. The score results of depression, anxiety, and stress are calculated by adding the points for each relevant scale. The reliability scores of the scales in terms of Cronbach's alpha scores rate the depression scale at 0.91, the anxiety scale at 0.84, and the stress scale at 0.90 in the normative sample (15,16).

SF-36

The Medical Outcomes Study Short Form 36 (SF-36) involves eight domains of general health: physical function, social function, role–emotional, role–physical, mental health, vitality, pain and general health. The maximum score in each domain is 100, and a high score is desirable and indicative of better well-being or less pain. Changes in the score of 5 units are clinically relevant (17). SF-36 has shown consistently high levels of reliability (test-retest, internal consistency) and validity (content, concurrent, criterion, construct, predictive) (18).

Sample size

The number of participants was calculated using software G*Power Version 3.1.9.2 using the data of study done by Atlantis (19) in which the pre (10.6 ± 8.8) and post values (4 ± 3.4) of stress score were analyzed by using the difference between two dependent means (matched pairs) and effect size came out to be 0.858. Total 30 subjects (15 subjects in each group), including 15% dropouts, were shown to be necessary with the effect size of 0.858, α=0.05, power (1-β) = 0.80.

Data analysis

Data were analyzed with SPSS version 23.0. The normality distribution of all outcome measures was verified using the Shapiro-Wilk test, skewness and histogram. The outcome variables which show non-normal distribution were analyzed using a non-parametric test or log-transformed. Baseline measures and demographic variables between the two groups were determined using independent sample t-test or Mann-Whitney U test. 2×2 repeated measure analysis of variance (ANOVA) was used to outcome measures to find out between-group effect (Exercise group and WBV group), within-group effect (Pre-values and Post-values) and time×intervention interaction effect. If the baseline measures between groups were found to be significant, then 2×2 repeated measure analysis of covariance (ANCOVA) was used, considering pre-values as co-variate. In addition, the change between the pre and post-values was analyzed using the independent t-test to find out the significant difference between the groups. All comparisons were considered significant at $p \leq 0.05$, and the confidence interval was set at 95%.

Results

A total of 50 participants were assessed for eligibility. Eight were excluded due to higher scores on DASS, and 12 participants declined to participate. Of the 30 participants included, 21 were females (70%), and nine were males (30%). There were 12 females and three males in the WBV group and nine females and six males in the exercise group.

Depression, anxiety and stress were non-significant at baseline ($p>0.05$). The physical functioning component of SF-36 was significant at baseline comparison between the groups ($p=0.04$) (Table 1). Role limitation due to physical health ($p=0.01$) and emotional problems ($p=0.03$) was analyzed using the Mann-Witney U test showed a significant difference between the groups at baseline (Table 1).

Depression ($F_{(1,28)} = 95.28$, $p < 0.001$), anxiety ($F_{(1,28)} = 45.58$, $p < 0.001$) and stress ($F_{(1,28)} = 30.81$, $p < 0.001$) was found to be significant for within group effects while between group effect was found to be non-significant for all components of DASS. Time×intervention interaction effect was found significant for depression ($F_{(1,28)} = 10.58$, $p = 0.003$), and stress ($F_{(1,28)} = 4.96$, $p = 0.03$), whereas anxiety $F_{(1,28)} = 2.46$, $p=0.12$), showed non-significant (Table 2). The change (pre-post) in depression ($p=0.003$) and stress ($p=0.034$) was found to be significant difference whereas the anxiety ($p=0.128$) showed non-significant difference between exercise and WBV groups (Table 2).

Table 2: Comparison of DASS scores at baseline (Pre) and after 4 weeks (Post) of intervention.

Outcome variables	Exercise group Mean ± SD	WBV group Mean ± SD	Independent t-test t (p-value)	Within group effect η_p^2 (p-value)	Between group effect η_p^2 (p-value)	Time×Intervention Interaction effect η_p^2 (p-value)
Depression						
Pre	19.47 ± 9.15	15.93 ± 6.6		0.77 (<0.001)*	0.09 (0.09)	0.27 (0.003)*
Post	16.53 ± 8.78	10.07 ± 7.2				
Pre-post (Change)	2.93 ± 1.98	5.86±2.87	3.25 (0.003)*			
Anxiety						
Pre	15.5 ± 7.32	12.13 ± 5.60		0.61 (<0.001)*	0.1 (0.08)	0.08 (0.12)
Post	12.93 ± 7.23	8.07 ± 5.45				
Pre-post (Change)	2.53±1.99	4.06±3.21	1.56 (0.128)			
Stress						
Pre	23.40 ± 7.84	20.7 ± 6.22		0.52 (<0.001)*	0.1 (0.07)	0.15 (0.03)*

Post	20.67 ± 6.14	14.33 ± 7.9	
Pre-post (Change)	2.73±3.84	6.4±5.08	2.22 (0.034)*

General health ($F_{(1,28)}$ = 44.18, p < 0.001), Physical functioning ($F_{(1,27)}$ = 181.58, p < 0.001), role limitations due to physical health ($F_{(1,27)}$ = 151.9, p < 0.001), role limitations due to emotional problems ($F_{(1,27)}$ = 169.68, p < 0.001), social functioning ($F_{(1,28)}$ = 62.31, p < 0.001), pain ($F_{(1,28)}$ = 103.36, p < 0.001), energy/fatigue ($F_{(1,28)}$ = 129.73, p < 0.001) and emotional well-being ($F_{(1,28)}$ = 114.8, p < 0.001) was found to be significant for within group effect whereas between group effect was found to be non-significant for all SF-36 component except role limitation due to emotional problems ($F_{(1,27)}$ = 5.43, p = 0.04) (Table 3). Time×intervention interaction effect was found to be significant only for role limitations due to physical health ($F_{(1,27)}$ = 5.42, p = 0.03), energy/fatigue ($F_{(1,28)}$ = 8.84, p = 0.006) and emotional well-being ($F_{(1,28)}$ = 7.52, p = 0.01) (Table 3). Role limitations due to physical health (p<0.001), role limitations due to emotional problems (p=0.05), energy/fatigue (p=0.007) and emotional well-being (p=0.01) was found to be significant difference between the exercise and WBV group whereas other domains of SF-36 were found non-significant different between the groups.

Table 3: Comparison of values of SF-36 at baseline and after 4 weeks of intervention.

Outcome variables	**Exercise group**	**WBV group**	**Independent t-test**	**Within group effect**	**Between group effect**	**Time×Intervention Interaction effect**
	Mean ± SD	**Mean ± SD**	**t (p-value)**	**η_p^2 (p-value)**	**η_p^2 (p-value)**	**η_p^2 (p-value)**
General Health						
Pre	55.27 ± 22.63	56.11 ± 18.49		0.61 (<0.001)*	0.04 (0.28)	0.11 (0.06)
Post	69.44 ± 21.34	81.94 ± 8.43				
Post-pre (Change)	14.1 ± 16.9	25.83 ± 15.99	1.93 (0.063)			
Physical Functioning						
Pre	83 ± 12.51	70.67 ± 17.71		0.87 (<0.001)*	0.0001 (0.99)	0.0001 (0.99)
Post	95.33 ± 6.93	92.67 ± 6.51				
Post-pre (Change)	12.33 ± 10.15	22 ± 15.9	1.98 (0.057)			
Role Limitation due to Physical Health[a]						
Pre	58.33 ± 36.19	25 ± 31.34		0.89 (<0.001)*	0.09 (0.2)	0.24 (0.03)*
Post	83.33 ± 27.81	88.33 ± 18.58				
Post-pre (Change)	25 ± 23.14	63.33 ± 29.68	3.94 (<0.001)*			

Role Limitation due to Emotional Problems[a]						
Pre	37.77 ± 30.51	15.55 ± 30.51		0.93 (<0.001)*	0.33 (0.04)*	0.09 (0.31)
Post	68.89 ± 38.76	64.44 ± 29.45				
Post-pre (Change)	31.11 ± 15.25	48.88 ± 30.51	2.01 (0.05)*			
Social Functioning						
Pre	55 ± 23.05	59.17 ± 12.01		0.69 (<0.001)*	0.06 (0.16)	0.07 (0.13)
Post	74.16 ± 24.76	87.5 ± 9.44				
Post-pre (Change)	19.16 ± 21.58	28.33 ± 8.79	1.52 (0.139)			
Pain						
Pre	67 ± 21.84	55.67 ± 21.1		0.78 (<0.001)*	0.06 (0.18)	0.05 (0.2)
Post	87.66 ± 15.04	82.33 ± 11.59				
Post-pre (Change)	20.66 ± 11.74	26.66 ± 13.68	1.28 (0.208)			
Energy/Fatigue						
Pre	47.33 ± 16.99	44.67 ± 12.17		0.82 (<0.001)*	0.02 (0.37)	0.24 (0.006)*
Post	66.67 ± 18.29	77.67 ± 5.62				
Post-pre (Change)	19.33 ± 15.79	33 ± 8.19	2.97 (0.007)*			
Emotional Well Being						
Pre	49.87 ± 19.82	54.13 ± 14.49		0.8 (<0.001)*	0.09 (0.1)	0.21 (0.01)*
Post	66.13 ± 21.79	81.6 ± 9.41				
Post-pre (Change)	16.26 ± 13.22	27.46 ± 8.66	**2.74 (0.01)***			

WBV: Whole body vibration; DASS: Depression anxiety stress score; SF-36: Short form 36; [a]: analyses were done using log transformed values; *: significant difference.

Discussion

The study's main objective was to compare the effects of exercise with WBV and exercise without WBV on depression, anxiety and stress and QoL in collegiate students. There were no baseline differences in domains of DASS (Depression, Anxiety and Stress) or SF-36 except for physical functioning, role limitation due to physical health and role limitation due to emotional problems.

After four weeks of intervention, there was an improvement in all the components of DASS and SF-36 in both the WBV and exercise groups. The present study found more significant improvement in the WBV group in comparison with the exercise group for

depression, stress and role limitations due to physical health, role limitations due to emotional problems, energy/fatigue and emotional well being

Depression

The impact of exercise on depression has always been the focus of various research throughout history. Exercise is reportedly needed to improve symptoms of depression (20). Depressive disorders are amongst the most significant human health problems. To prevent depression, improving diets and related workouts are significant elements in recovery progress (21).

In contrast to our study, Aksoy, reported the difference between both the WBV training group's pre and post - test scores and the control group's post - test BDI scores at the end of the 12th week as being statistically significant. It was ascertained that consistent 12-week WBV training was effective in lowering the symptoms of depression. He concluded, because the efficacy of the whole body vibration training has a short period of time for application and is healthier, individuals might be advised to carry out whole body vibration training to minimize depression rates (11).

According to the findings in our study, there was a significant difference between the pre and post - test scores of both the groups but the post-test depression scores of the WBV and exercise group wasn't found to be statistically significant. It could be attributed to reduced training duration of 4 weeks only.

Similar to our study, Wunram et al., reported that aerobic exercise (endurance cycling) and WBV training were similarly successful for depressed adolescents and preferable to the normal therapy. They found easy-to-perform WBV strength conditioning has comparable results to the more rigorous cycling program (22). As per Carter, more passive training will be necessary when the depressive symptoms become more severe (23). Wunram reported that the WBV group was more encouraged (almost significantly) than the cycling group to continue exercising after the experiment also. So, this type of training seems to be feasible in everyday routine for youngsters. The unsupervised or running activities are complicated owing to the disease itself. Their findings were fascinating because the shorter the exercise therapy needed is to become effective, the easier it is to motivate youngsters to train. This is particularly attractive in terms of the WBV condition as it is easy to perform, it could also be used as a "bridging" technique when more active exercise due to the depressive condition is still not possible.

Anxiety

Smits stated that there is significant correlation between physical inactivity and higher rates of sensitivity to anxiety. Reason could be that physical inactivity can enhance emotional sensitivity to bodily perceptions that aid in sustaining panic disorder (24). In a research conducted by B. Wipli, the participants in both groups (control and exercise group) had reduced anxiety from pre- to post-intervention. In exercise group, anxiety reductions were significantly higher and non-significant than stretching-control group. However, the processes by which such decreases exist have not been researched thoroughly (12). A systematic review concluded that exercise tends to be beneficial as an adjunctive intervention for anxiety disorders but less successful than antidepressant therapy. Both aerobic and non-aerobic activity tend to reduce signs of anxiety in acute periods (25). According to our findings also, there was a significant difference within the pre and post - test scores of both the training groups but the post-test depression scores of the WBV and exercise group wasn't found to be statistically significant. Despite these studies, Petruzzello et al., performed three independent meta-analyzes and the results support the argument that exercise is correlated with anxiety reduction. The claim was because exercise had effects on anxieties in healthy people, but not on clinically diagnosed anxiety conditions (26).

Stress

Researches into exercise & stress has usually concentrated on aerobic exercise. Consistent results have been reported that participants feel more relaxed after a 20-30 minutes aerobic workout and the relaxing impact will last many hours after workout (27). Human & animal studies revealed that becoming physically active strengthens the way body regulates stress due to improvements in response to the hormone & that exercise stimulates brain neurotransmitters like serotonin and dopamine, which influence mood and behavior (28).

Besides the potential physiological mechanism, there is also a possibility that exercise can act as a moment-out or escape from the stressor. In 1998, a research conducted by Breus evaluated the time-out hypothesis using a regimen that had participants exercising but didn't grant a break from the stress during the session of exercise. College aged women were the participants who mentioned being their greatest stressor in studying. Before and after four situations over 4 days, the state of "exercising only" has the biggest soothing impact (29). In contrast to Erica M Jackson, Bass performed an eight-week intervention on psychological stress in college students, that showed weight lifting usually performed at a lower level was accompanied by enhanced optimistic stress reduction. These findings indicates that aerobic activity might not

be sufficient to relieve psychological stress but that the same benefits can also be generated through resistance training. It may not be necessary to take more intensive aerobic training to reduce psychological stress (30). The findings in our study showed there was a significant difference between the pre and post - test scores of both the groups but the post-test depression scores of the WBV and exercise group wasn't found to be statistically significant. This could be attributed to short duration of intervention (only 4 weeks, 2 sessions/week). Jong Ho Kim, in his study titled "The impact of physical exercise on stress coping and well-being in the context of leisure in university students" reported that most of his participants answered that they had a calm mind and concentration, resulting from positive emotion after leisurely physical activity that allows them to capitalize on successful problem-focused coping and problem-solving effectiveness. Two of the participants have stated specifically that they are adopting a more constructive approach to addressing challenges in the face of uncertainty and stress, rather than ignoring the issue or accusing others. That method of coping strategy as opposed to an avoidance style of coping will play a major role in successfully dealing with stress. Designed breather leisure stress management is favorably correlated with mastery-oriented ambitions, successful time control and procrastination linked negatively.

Quality of Life

A study conducted by Arslan, reported that prevalence of depression among Turkish university students was widespread, negatively affecting the student's Health Related QoL (HRQOL) (31). Erkan, also revealed negative correlations exist between depression & QoL in students. Similar to our findings, pre-intervention DASS scores were quite high and same as seen in earlier studies the SF-36 results were poor. And post intervention there were significant difference in the DASS scores in 2 domains (depression and stress) within time and group and in anxiety with time. And in return QoL was improved in all domains of SF-36 with time and 4 domains improved significantly within group (Role limitation due to physical health, Role limitation due to emotional problems, Energy/Fatigue, and Emotional well-being). Olivares et al., showed a 12-week course of tilting whole body vibration therapy was associated with higher scores of Fibromyalgia Impact Questionnaire (FIQ).

Individuals with fibromyalgia are typically less physically involved than the individuals generally and the results of tilting whole body vibration may have been partially due to the already sedentary participants being reconditioned. This could be due to the long duration of

the treatment and because he didn't used the traditional exercise on WBV platform, he used tilting of the platform which might helped (32). In our study also the participants were untrained at inclusion and were mostly sedentary. Hence, that might help in such results in shorter duration of intervention.

Bruyere, also revealed that controlled WBV can improve elements of fall risk and HRQoL in elderly patients. With the vibration intervention there was improvement in the physical function measurement and was well correlated with the timed up and go test. Though there was no improvement in the intervention group from baseline in health change component. Similarly, in present study, physical functioning was the only domain of SF-36 which improved significantly between the groups and with time that can be because of effects on muscular performance (33). Barbosa, found improvement in QoL in relation to the falls in elderly with the help of WBV training. And more motor units are triggered in reaction to the vibration stimuli (tonic vibration stimulus), contributing to a stronger neuromuscular reaction. WBV enhanced biomechanical variables such as muscle power, flexibility and strength, resulting in a positive impact on dynamic efficiency (as demonstrated by the improvements in lower limb muscle performance and the improvements shown in the study's TUG score). And in return all these factors improved the quality of life (34).

Alev, found that only FIQ score was significantly higher in the treatment group, than VAS and BDI at the 6th month of the WBV training group. It happened because it can be used easily in untrained people with a relatively shorter application procedure compared to conventional exercise sessions. Pain relief may be a consequence of the neurons' regulation or plastic properties in response to the vibrational impulse. FIQ was the only variable in the study which showed significant changes after 3 months and longer duration training affect or residual effect shown at 6th month) (35).

In current study almost all the domains of SF-36 improved from pre-post intervention with time within the group. The results weren't significant between the groups as it might be because of no significant difference was found in DASS scores between the groups and we saw that depression is inversely proportional to QoL. And reason for no significant difference in DASS score was described earlier also i.e., less duration of training., only 4 weeks. And as interaction with time is seen in all the variables of DASS and SF-36, if the same protocol would be followed for longer duration can result in improvement in depression and QOL which will be significantly visible. As the physical functioning was the only domain in SF-36 which revealed significant difference between groups, but it wasn't significantly similar at the baseline in both

the groups. We can see that the WBV group improved with time as compared to the exercise training group. Hence, time could also be a reason for the significant difference.

One of the limitations of the study was short duration of intervention (8 sessions only) and absence of follow up after the study. The sample size could be larger and baseline characteristics differences are other limitations which may not help in generalization of the results to general population.

Conclusions

Based on the results, the addition of WBV training is suggested during college studies which can help in reducing depression, anxiety, stress and improvement in quality of life. The therapeutic model is safe, effective and less demanding in clinical settings for the students with these issues.

Declaration

Ethics and consent to participate

The study was approved by the Institutional Ethical Committee (IEC), Jamia Millia Islamia (Central University), New Delhi, India with Reference number 26/11/263/JMI/IEC/2019.
Informed written consent was obtained from each participant included in the study and the study protocol conforms to the ethical guidelines.

Consent for publication

Yes, all the authors provide consent for the publication of this study in this journal.

Availability of data and materials

The Data collected and/or analyzed related to the study are available from the corresponding author on reasonable request and after institutional approval.

Competing Interest

Authors have no conflicts of interests that might be interpreted as influencing the research.

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Author's contribution

Study concept and design: Geetanjli Chawla and Muhammad Azharuddin. Participants enrollment and assignment: Muhammad Azharuddin and Irshad Ahmad. Acquisition of data: Geetanjli Chawla and Muhammad Azharuddin. Analysis and interpretation of data: Irshad Ahmad and M Ejaz Hussain. Drafting of the article: Geetanjli Chawla, Muhammad Azharuddin, Irshad Ahmad and M Ejaz Hussain. Critical revision: Irshad Ahmad and M Ejaz Hussain. Supervision of the study: Muhammad Azharuddin and M Ejaz Hussain.

Authors declare that the above-mentioned manuscript has not been published or considered for publication elsewhere.

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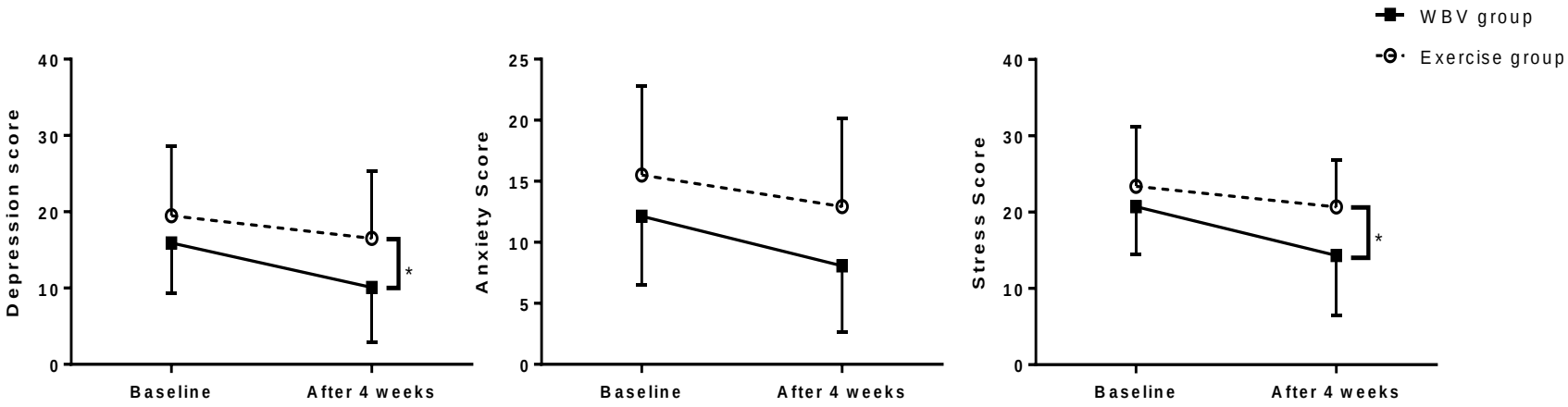

Figure 1. Outcome variables of DASS at baseline and after 4 weeks in WBV and exercise group.

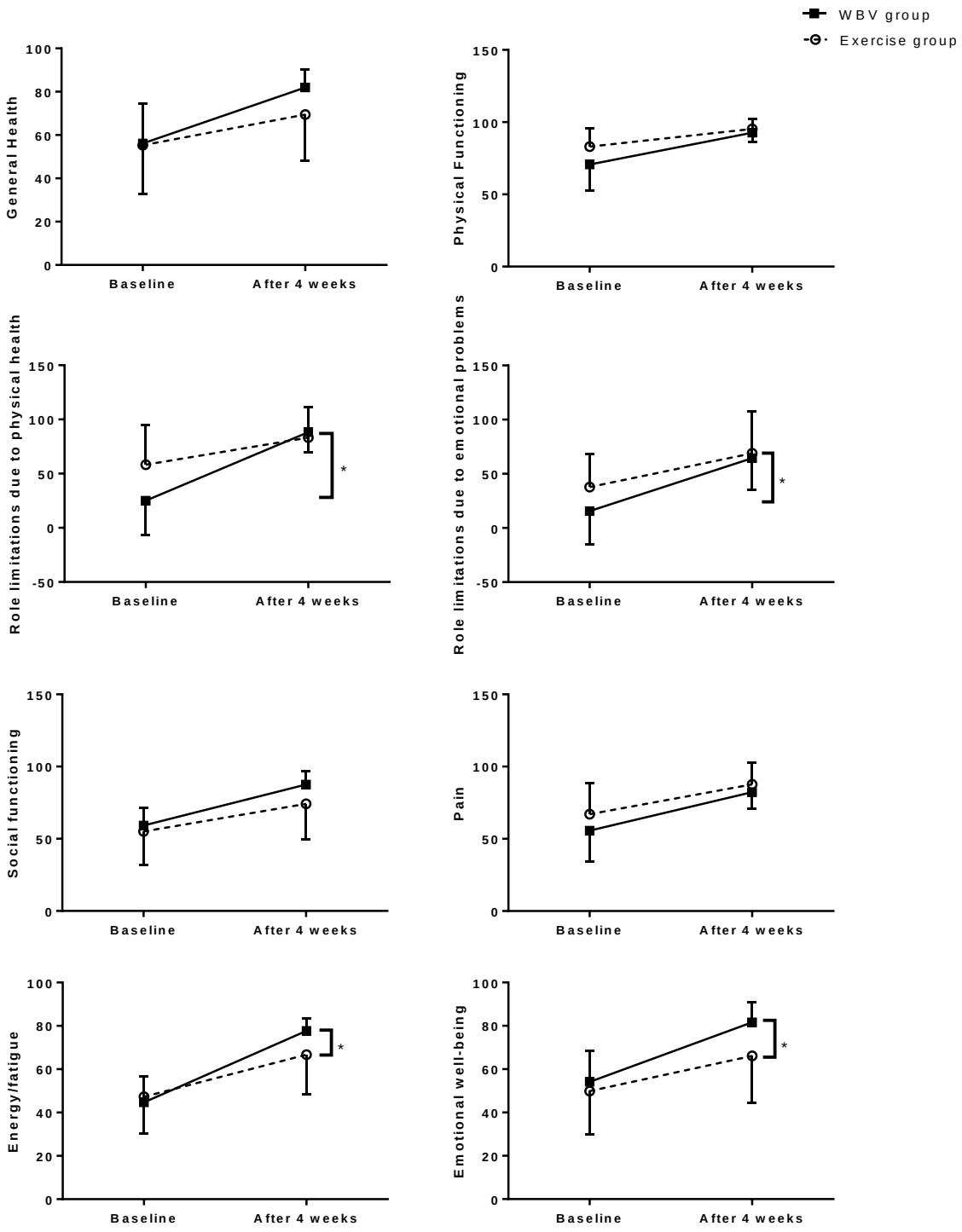

Figure 2. Outcome variables of different component of SF-36 at baseline and after 4 weeks in WBV and exercise group.