

Single Vibroacoustic Impact Effect of Singing Bowls over the Psycho-Emotional State and Cardiovascular System Work

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Abstract: This article presents a two-stage study result of the author's method of vibroacoustic massage using singing bowls application. At the first stage, the effect of vibroacoustic massage single application over psycho-emotional characteristics was studied. 19 studied volunteers took part in our study. The testing results before and after exposures were compared according to the WAM (Weighted average mark), Zung, and Spielberg-Khanin tests. The study of the psycho-emotional sphere showed that after the vibroacoustic massage procedure, the indicators of "well-being" and "activity" of the WAM test significantly improved ($p = 0.002$). In addition, the depression level determined by the Zung test, personal anxiety indicators ($p = 0.004$), and situational anxiety ones ($p = 0.028$) decreased. At the second stage, 62 volunteers were divided into two groups. The first group underwent a vibroacoustic massage session according to the patented author's method. The second group received only acoustic exposure using only singing bowls. Differences in the Kerdo index were revealed in the dynamics, and in the first group, the changes were less significant than in the second one. Changes in heart rate variability characteristics for both groups were similar: there was an increase in parasympathetic influences at rest and during the orthostatic test (increased levels of RMSSD (Root Mean Square of Successive Differences), NN50, pNN50) and a decrease in sympathetic effects at rest and their slight increase with orthostatic loading (TINN, RR triangular index). The dynamics were more significant in the first group that received a vibroacoustic massage session. When assessing changes in the neurovegetative regulation levels activity of the heart rhythm, the main difference was associated with very low-frequency waves power dynamics during the orthostatic test. Thus, vibroacoustic massage using singing bowls improves the psycho-emotional state, reduces depression and anxiety, and increases Parasympaticus (autonomic nervous system) activity.

Keywords: Vibroacoustic massage, psycho-emotional state, hemodynamics, adaptation, singing bowls.

INTRODUCTION

The beneficial effect of sound has been used for a long time by humanity in practice. Music therapy can curtail several pathological conditions, including mental disorders and pain syndrome [1-4]. Researchers also note the positive effect of meditative states on some physiological parameters and learning ability [5, 6]. The combination of meditation and sound exposure can provide additional synergistic effects. Singing bowls use can be such an integrative influence variant. Experimental meditation with singing bowls ($n = 62$) led to a decrease in tension, anger, fatigue, depression, and an increase in spiritual well-being feeling ($p < 0.001$). For participants who had not previously practiced these methods, the effect was even greater [7]. Similar data on singing bowl's effects on distress, anxiety, depression, fatigue, stress was obtained in another study [4]. This work also indicated exposure to Tibetan bowls to normalize blood pressure, heart rate, oxygen saturation in peripheral capillaries, cutaneous conduction, and restore alpha rhythms in a brain's anterior frontal region.

Another study evaluated the singing bowls effect versus relaxation on the back. The heart rate variability (HRV) parameters were used as assessment criteria, including heart rate (HR) and standard deviation of the RR interval (RMSSD), which correlates with parasympathetic activity. The singing bowls use resulted in significant reductions in stress index, heart rate, and an increase in RMSSD, indicating improved adaptation processes [8]. Singing bowls were first used in the 5th century BC in the fire cult in the Himalayas. Later they were used in meditation and religious rituals. The exact composition of the Tibetan bowls is not regulated. Usually, their alloy consists of bronze with inclusions of silver, zinc, iron, gold, and nickel [9]. The Tibetan bowl is a standing bell; when struck, a complex composition sound is formed. When the bowl is filled with water, ripples and surface waves are formed on its surface upon impact. If the effect is powerful, then the breakage of the waves creates droplets rising into the air. The vibrations frequency generated by the bowl depends on the material it is made of, and the shape of the waves generated depends on the bowl geometry [9].

The ability of singing bowls to generate wave effects in liquid upon singing bowl contact with the body, most likely, can determine their biological effect on cells, containing 70-80% water. Each physical system has its

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own resonant frequency. Resonance is defined as a phenomenon in which an oscillating system can absorb energy from an external source with certain efficiency at only one specific frequency. Bio-resonance produced by sound works on two levels: mechanical-acoustic and electromagnetic. Cells can also produce their own sound vibrations, the characteristics of which may be the result of gene expression and associated metabolic processes. Specially selected vibrations of a specific frequency can modulate cellular activity [10]. One study attempted to use acoustic sonification using singing bowls to diagnose blood pressure [11]. One pilot study examined the effects of Tibetan singing bowls on 12 patients with metastatic cancer, both non-contact and body contact. The vibroacoustic effect was carried out during 6 sessions. At the end of the course of the vibroacoustic massage, according to the Bagno Armonico method, there was a decrease in the conduction level, an increase in heart rate variability, an increase in α -, β -, and inter-hemispheric coherence. Reductions in anxiety, agitation, involuntary mental alertness, and stress were noted [12].

Exposure to quartz singing bowls in patients ($n = 54$) with back pain had a nonspecific effect. Despite a significant reduction in pain intensity compared with the zero group, there were no significant differences compared with the placebo group. Thus, it was not possible to prove the analgesic effect of singing bowls [13]. A study of the combined effect of singing bowls and relaxation found significant reductions in blood pressure, heart rate, and improvement in the emotional state compared to relaxation [14]. The study hypothesis was that a single exposure to singing bowls, according to the author's method [15-17], combining minimal non-contact and main contact effect, on the cardiovascular and autonomic nervous systems work and psycho-emotional state is more effective than isolated acoustic exposure with singing bowls. A singing bowl made of bell bronze was used for the session [18-20]. The bowl dimensions were as follows: diameter 25 cm; height 11 cm; bottom diameter 13 cm. The bowl was placed directly on the subject's body and, holding it with one hand, hit the bowl with a special stick with a wooden handle and a rubber tip. In each position, the bowl was struck 9 times with an interval of 1 second between strikes, then it was moved to the next position, and the procedure was repeated. The session lasted for 50 minutes [21-23].

This work aims to study the effect of a single exposure to singing bowls over the parameters of psycho-emotional well-being, depression and anxiety

levels, hemodynamic parameters, including the minute volume of oxygen, Kerdo index, WAM scale, and HRV characteristics.

MATERIALS AND METHODS

The study of the physiological effects of the influence of the author's method of vibroacoustic massage by the method of "singing bowls" was carried out in two stages - on the basis of the Ural State University of Physical Culture (UralSUPC), Chelyabinsk, Russian Federation (the first stage) and Yoga Studio "Mint" ("Myata") in Dzerzhinsk, Nizhegorodskaya region, Russian Federation (Yoga-Studios "Mint") (second stage). The studies were carried out in accordance with the rules of the 1975 Declaration of Helsinki, revised in 2013. The study was approved by the ethics committee of Ural SUPC. All subjects signed informed consent for its conduct. At the first stage, a group of 19 volunteers was randomly selected: 15 women and 4 men. The age range ranged from 19 to 58 years. The average age was 30.36 ± 13.94 years. At the second stage, the number of people in the group was 62: 43 men and 19 women. The experimental (first) group included 31 people; control (second) - 31 people. In the experimental group, a session of vibroacoustic massage by singing bowls was performed. In the control group, an isolated acoustic effect by singing bowls was performed. The bowl was located within auditory accessibility but at a distance of about two meters from the subject. The average age (\pm SD (Standard Deviation)) in the first group was 38.65 ± 9.28 years, in the second - 35.55 ± 4.75 ($p > 0.05$) [24-26].

A single effect on the psychological state was assessed using three WAM scales (well-being, activity, mood), the Zung test (screening for depression), and the Spielberg-Khanin anxiety scale. The WAM test contains 30 questions divided into 3 clusters: health, activity, and mood [27]. The answer to each question ranges from 1 to 7 points. The answers are summed up by clusters and divided by 10. The final result above 4 for each cluster indicates a favorable state of the subject. Zung's test consists of 20 questions, and each scored in a 1-4 point range [28]. The degree of depression was assessed as follows: 25-49 - normal; 50-59 - mild depression; 60-69 - moderate depression; 70 and above - severe depression. The Spielberg-Khanin scale contains 40 questions, equally divided into 2 clusters: situational anxiety and personal anxiety [29]. The answer to each question is weighted on a 4-point scale. The anxiety level is determined by the sum

of points: less than 30 points – low; 30-44 – moderate; 45 or more – high anxiety. At the second stage of the study, to assess the effect of vibroacoustic massage before and after the procedure, each subject was taken an ECG for 10 minutes in the supine position and measured blood pressure and heart rate. Also, an orthostatic test was performed before and after the procedure; a subject rose from a lying position to a vertical one. The ECG (Electrocardiography) was recorded for 10 minutes during the orthostatic test before and after the procedure. Each subject was measured heart rate (HR), systolic (SBP), and diastolic blood pressure (DBP). To clarify the nature of the autonomic nervous system functioning and the blood circulation regulation, the following indicators were calculated: Kerdo's vegetative index (conventional units), minute blood volume (ml/min), and the coefficient of blood circulation efficiency (conventional units) [30-32]. The Kerdo vegetative Index (VIK) was calculated using the formula:

$$VIK = 100 * \left(1 - \frac{DBP}{HR}\right), \quad (1)$$

where: DBP – diastolic blood pressure, HR – heart rate. The oxygen minute volume (OMV) was calculated using the formula:

$$OMV = SV * HR, \quad (2)$$

where: SV is the systolic volume, determined by the formula:

$$SV = 90.97 + 0.54 * PP - 0.57 * DBP - 0.61 * Age, \quad (3)$$

Where: PP is the pulse pressure. The blood flow efficiency coefficient (BFEC) was calculated using the formula:

$$BFEC = (SBP - DBP) * HR, \quad (4)$$

VIK reflects the balance of the sympathetic and parasympathetic divisions of the autonomic nervous system. The OMV indicates the volume of blood passing through the heart in 1 minute. BFEC is indicative of the heart load degree. The electrocardiography (ECG) results were also used to assess heart rate variability (HRV), which was carried out using a USB attachment to a PC "ECG Lite" (version "AIT Cardio", Russia) and analyzed using the Kubios HRV software (on a PC with Windows), on which the artifacts were corrected in manual mode, and a five-minute interval was selected for further analysis. As a result, a report was generated for these five-

minute intervals, the results of which were loaded for calculations, processing, and further statistical analysis [33-35]. When assessing HRV indicators, the following indicators were studied:

- Mean RR (ms) the RR-interval average value in milliseconds;
- STD (standard deviation) RR (ms) standard deviation of all RR-intervals;
- Mean HR (1/min) average heart rate per minute;
- STD HR (standard deviation heart rate) (1/min) standard deviation of instantaneous heart rate values;
- RMSSD (ms) square root of the average sum of squares of the differences between adjacent RR-intervals;
- NN50 (count) the number of neighboring RR-intervals pairs differing by more than 50 ms during the entire recording;
- pNN50 (%) NN50 value divided by the total number of RR-intervals;
- RR triangular index – the total number of RR intervals divided by the height of all RR intervals histogram with a step of 7.8125 ms (1/128 ms);
- TINN (triangular interpolation of NN interval histogram) (ms) width of the root-mean-square triangular interpolation base of the highest peak of the histogram built overall RR-intervals;
- VLF (Very low frequency) (ms^2) power of the very low-frequency range in milliseconds squared;
- LF (Low Frequency) (ms^2) power of the low-frequency range in milliseconds squared;
- HF (High-Frequency) (ms^2) power of the high-frequency range in milliseconds squared;
- VLF (very low frequency) (%) power of the very low-frequency range in percent;
- LF (%) power of the low-frequency range in percent;
- HF (%) power of the high-frequency range in percent;

- Total power (ms^2) total power of spectral components in milliseconds squared;
- LF/HF ratio vegetative balance – LF/HF power ratio.

Statistical processing of the results was carried out using the Statistica 10.0 software [36-38]. The significance of differences for psychological tests was assessed using the paired Wilcoxon test for related samples. The results of calculating VIK, OMV, and BFEC were compared across groups using paired t-test (before and after the procedure) and Student's independent t-test (comparison between groups). The main method for assessing HRV results was calculations using the Mann-Whitney U-test (comparison between groups) and the Wilcoxon test (dynamics within groups for dependent variables) for

nonparametric data. The significance level $p = 0.05$ was taken as a threshold.

RESULTS

The study of the psycho-emotional state using the WAM test showed that the vibroacoustic massage use causes a significant improvement in the "well-being" and "activity" indicators, but in comparison with the subjects' state before the procedure, there were no changes in the "mood" scale (Table 1, Figure 1).

Zung test scores indicated a significant decrease in the level of depression in the group from 30.84 ± 8.30 points to 34.37 ± 7.54 points ($p = 0.006$). The beneficial effect of vibroacoustic massage was also manifested in a decrease in situational ($p = 0.028$) and personal

Table 1: The Results of the Questionnaire Survey on the Scales of Psycho-Emotional Well-Being

Questionnaire cluster	n	Before the procedure (M±SD)	After the procedure (M±SD)	p-value
Scale WAM				
Well-being	17	4.98±1.16	6.09±0.68	0.002*
Activity	17	4.57±1.01	5.45±0.73	0.002*
Mood	17	5.81±0.73	5.99±0.98	0.244
Zung test				
-	19	34.37±7	30.84±8.30	0.006*
Spielberg-Khaninscale				
Situational anxiety	19	39.26±9.12	34.26±6.79	0.028*
Personal anxiety	19	41.42±7.52	35.95±8.82	0.004*

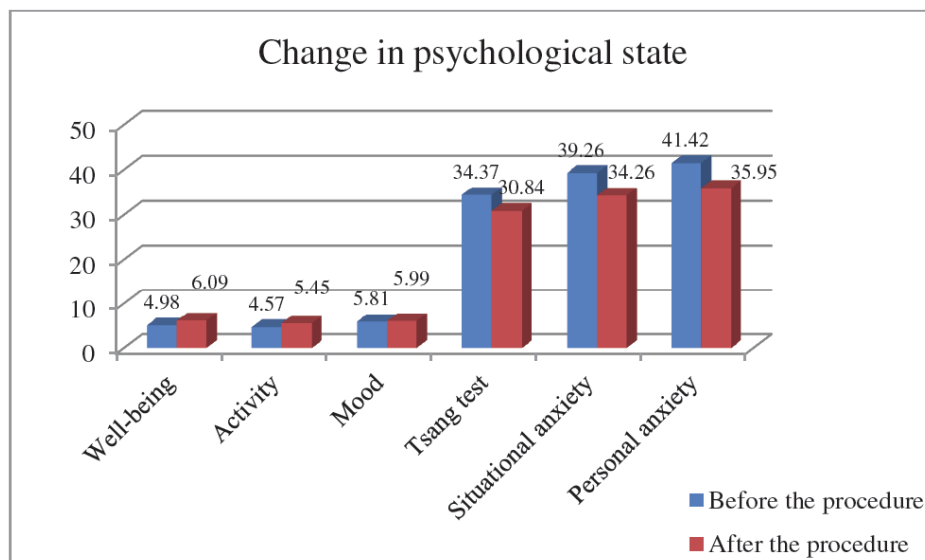


Figure 1: Change in psychological state after vibroacoustic massage.

Table 2: Assessment of Indicators in the First and the Second Group

Indicators	Before the procedure			After the procedure			T	p-value
	Average Value	Median	SD	Average Value	Median	SD		
First group								
HR	66.37	65.40	8.85	59.99	58.60	6.57	30	0.001
VIK	-5.68	-5.46	16.30	-17.81	-17.40	14.57	36	0.001
OMV	3390.35	3444.34	878.17	2961.49	2959.35	622.56	74	0.001
BFEC	2853.53	2778.16	560.47	2501.25	2469.09	468.48	106	0.005
Second group								
HR	66.77	66.57	10.12	61.78	61.31	8.07	13	0.001
VIK	-5.32	-3.89	18.64	-13.92	-10.10	18.22	51	0.001
OMV	3442.62	3429.44	666.92	3122.27	3195.56	571.95	50	0.001
BFEC	2641.36	2678.61	503.38	2357.70	2396.55	415.10	81	0.001

anxiety ($p = 0.004$). Cardiovascular system and HRV indicators analysis reflected a number of changes occurring after the procedure and compared changes in the first and second groups (Table 2) [39-41].

Thus, in both groups, significant changes in HR, VIK, OMV, and BFEC were noted when comparing the values after the vibroacoustic massage session with the values before the procedure ($p > 0.05$) [42-44]. To assess the reliability of changes between the experimental and control groups, we generated new data series, which represented the difference (Δ) of the parameters of the same name after the procedure and before the procedure and compared by groups (Table 3).

For the values of Δ HR, Δ OMV, and Δ BFEC, the greatest amplitude of changes was observed in the experimental group; however, the differences between the groups were not significant ($p > 0.05$). The difference in the Kerdo vegetative index (Δ VIK) in the experimental group was lower than in the control group (1.58 mmHg*min vs. 3.06 mmHg*min; $p = 0.001$), which is possibly associated with the subjects'

emotional tension under the unusual procedure [45-47]. This assumption is consistent with work in which it was noted that the singing bowls effect was stronger if the person was already familiar with the procedure [7, 48, 49]. A separate analysis for women and men showed that men experienced more significant changes in all indicators after the procedure compared to the values before it [50-52]. So the parameters in men after the procedure and before it significantly differed for HR indicators 57.99 ± 5.27 beats/min vs. 63.86 ± 6.08 beats/min ($p = 0.001$); VIK -23.25 ± 14.94 conventional units vs. -10.94 ± 14.25 conventional units ($p = 0.001$); OMV 2829.88 ± 656.29 ml/min vs. 3223.66 ± 821.17 ml/min ($p = 0.001$); BFEC 2562.58 ± 476.92 conventional units vs. -2926.31 ± 529.96 conventional units ($p = 0.018$).

For women, similar parameters were as follows: HR 62.75 ± 7.38 beats/min vs. 69.85 ± 11.00 beats/min, ($p = 0.013$); VIK -10.30 ± 10.42 conventional units vs. 1.61 ± 16.65 conventional units, ($p = 0.013$); OMV 3143.70 ± 544.80 ml/min vs. 3621.15 ± 934.50 ml/min ($p = 0.046$); BFEC 2416.34 ± 461.53 conventional units vs. 2752.76 ± 607.05 conventional units ($p = 0.087$).

Table 3: Assessment of the Difference in Indicators (Δ) in both Groups

Indicators	1 group			2 group			T	p-value
	Average Value	Median	SD	Average Value	Median	SD		
Δ HR	-6.39	-6	6.93	-5	-3	5.17	-0.89	0.375
Δ VIK	1.58	2	0.50	3.06	3	0.57	-10.84	0.001
Δ MBF	-428.87	-385	613.75	-320.34	-241	357.76	-0.85	0.398
Δ CER	-352.28	-485	684.46	-283.66	-207	395.18	-0.48	0.631

*Note: Δ HR, Δ VIK, Δ OMV and Δ BFEC– the difference between mean values before and after the procedure.

Table 4: Sample Results for both Groups before and after the Procedure

Options	Background sample					Orthostatic test				
	Before the procedure		After the procedure		p	Before the procedure		After the procedure		p
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
First group										
Mean RR (ms)	915.27	132.94	993.94	168.01	0.001*	781.75	100.82	796.64	85.74	0.070
STD RR (ms)	51.47	22.31	57.36	25.14	0.096	49.43	38.69	50.69	23.62	0.001*
Mean HR (1/min)	67.32	11.35	59.80	5.70	0.001*	78.06	8.65	76.46	7.73	0.052
STD HR (1/min)	3.79	1.56	3.52	1.16	0.299	4.17	1.39	4.80	1.83	0.007*
RMSSD (ms)	36.02	19.15	47.51	27.21	0.006*	23.99	16.40	25.06	15.26	0.085
NN50 (count)	51.16	48.15	73.23	61.16	0.059	20.52	31.43	20.97	33.02	0.216
pNN50 (%)	16.63	16.97	25.48	21.42	0.003*	6.03	10.90	5.98	10.53	0.494
RR triangular index	12.23	4.07	13.29	4.72	0.468	10.15	3.77	11.97	4.12	0.001*
TINN (ms)	164.68	69.68	129.68	63.59	0.002*	188.39	62.50	221.94	66.97	0.001*
VLF Power (ms ²)	982.94	1305.33	1736.13	2479.91	0.022*	725.36	642.80	1576.32	2160.91	0.001*
LF Power (ms ²)	862.26	691.81	921.07	814.37	0.281	1065.19	1429.52	1369.13	1610.28	0.025*
HF Power (ms ²)	747.74	1314.21	1209.16	1638.06	0.030*	277.87	356.86	274.58	360.93	0.537
Total (ms ²)	2593.32	2341.02	3808.77	3754.81	0.052	2068.48	2064.43	3026.68	3461.15	0.003*
LF/HF Power (ms ²)	3.29	4.75	1.86	3.87	0.445	6.03	7.15	6.56	6.29	0.248
VLF Power (%)	36.42	23.73	43.69	21.12	0.158	39.77	22.57	48.15	18.91	0.013*
LF Power (%)	38.16	20.97	26.59	11.40	0.088	44.58	21.34	41.61	18.65	0.092
HF Power (%)	25.42	18.63	29.69	17.93	0.814	15.63	12.34	10.23	7.02	0.005*
Second group										
Mean RR(ms)	921.93	146.71	982.44	157.60	0.001*	707.30	140.25	735.46	137.43	0.001*
STD RR(ms)	46.76	22.18	54.35	24.69	0.001*	38.74	21.40	47.28	24.30	0.001*
Mean HR (1/min)	66.78	10.12	63.04	11.98	0.001*	87.11	17.10	84.44	14.34	0.001*
STD HR (1/min)	3.30	1.21	3.55	1.67	0.067	4.55	1.99	5.13	2.07	0.002*
RMSSD (ms)	40.86	27.09	46.55	26.13	0.002*	21.20	17.66	24.87	19.26	0.004*

(Table 4). Continued.

Options	Background sample					Orthostatic test				
	Before the procedure		After the procedure		p	Before the procedure		After the procedure		p
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
NN50 (count)	57.26	56.41	78.84	89.55	0.008*	20.00	37.08	26.71	40.36	0.023*
P NN50 (%)	19.04	19.63	24.43	21.84	0.003*	6.04	13.33	7.88	13.58	0.020*
RR triangular index	12.89	13.45	12.55	4.88	0.001*	9.78	4.62	10.92	4.48	0.025*
TINN (ms)	146.13	73.02	129.36	75.00	0.891	163.23	84.07	202.10	83.37	0.001*
VLF Power (ms ²)	903.68	935.39	1251.52	1665.28	0.055	632.13	859.69	892.97	962.45	0.004*
LF Power (ms ²)	728.71	963.62	807.90	754.34	0.362	764.74	891.44	1319.52	1250.18	0.001*
HF Power (ms ²)	1016.81	1765.63	969.61	1259.54	0.037*	396.58	853.33	429.68	775.52	0.399
Total (ms ²)	2649.84	2973.55	3030.13	3161.81	0.075	1793.61	2126.83	2642.55	2641.73	0.001*
LF/HF Power (ms ²)	1.13	0.89	1.59	2.07	0.695	5.75	5.65	8.57	8.08	0.006*
VLF Power (%)	39.15	19.13	38.18	17.94	0.829	38.65	14.46	35.40	13.11	0.203
LF Power (%)	27.59	14.93	29.54	17.43	0.695	44.20	18.72	49.51	14.52	0.063
HF Power (%)	33.22	16.39	32.25	17.93	0.984	17.15	14.44	14.11	13.97	0.019*

However, changes amplitude comparison in men and women did not reveal any differences [53-55]. The values of these changes in men and women, respectively, were equal for the parameters: $\Delta HR -5.89 \pm 4.16$ beats/min vs. -7.08 ± 9.73 beats/min, ($p = 0.645$); $\Delta VIK 1.61 \pm 0.50$ mmHg*min vs. 1.54 ± 0.52 mmHg* min, ($p = 0.698$); $\Delta OMV -393.78 \pm 501.20$ ml/min vs. -477.45 ± 762.52 ml/min ($p = 0.715$); $\Delta BFEC -363.74 \pm 653$ conventional units vs. -336.42 ± 751.96 conventional units ($p = 0.915$). HRV results for both groups reflect a number of significant differences for a large number of parameters before and after the procedure (Table 4).

In the second and first groups, similar changes were noted, reflecting an increase in parasympathetic influences and a decrease in the influence of the autonomic nervous system sympathetic division after the vibroacoustic massage procedure. In particular, there was an increase in RMSDD, NN50, and pNN50

values in both groups, which indicate parasympathetic activation after the procedure. However, a comparison between groups before and after the procedure showed a limited number of significant differences (Table 5).

The comparison between groups reflects differences in the high-frequency HF waves power ($p = 0.044$) and the LF/HF ratio ($p = 0.025$) before the procedure, which indicates a stronger activation of the sympathetic nervous system in the first group before the procedure [56-58]. However, these differences were almost smoothed out after the procedure, and the range of changes was much larger in the first group than in the second. Differences in the values of Mean RR and Mean HR were noted both before and after the procedure, and, probably, this is not related to the procedure itself, but only to group characteristics [59-61]. When performing orthostatic loading, the differences between groups in the power of very low-

Table 5: Values before and after the Procedure

Options	Before the procedure						After the procedure					
	Group 1		Group 2		U	p	Group 1		Group 2		U	p
	Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Resting-state (horizontal position)												
Mean RR (ms)	915.27	132.94	921.93	146.71	461	0.789	993.94	168.01	982.44	157.60	419	0.387
Mean HR (1/min)	67.32	11.35	66.78	10.12	462	0.800	59.80	5.70	63.04	11.98	407	0.304
VLF Power (ms ²)	982.94	1305.33	903.68	935.39	451	0.683	1736.13	2479.91	1251.52	1665.28	354	0.076
LF/HF Power (ms ²)	3.29	4.75	1.13	0.89	321	0.025*	1.86	3.87	1.59	2.07	437	0.545
VLF Power (%)	36.42	23.73	39.15	19.13	413	0.342	43.69	21.12	38.18	17.94	416	0.368
HF Power (%)	25.42	18.63	33.22	16.39	337	0.044*	29.69	17.93	32.25	17.93	446	0.627
Orthostatic test												
Mean RR (ms)	781.75	100.82	707.30	140.25	273	0.004*	796.64	85.74	735.46	137.43	293	0.01*
Mean HR (1/min)	78.06	8.65	87.11	17.10	278	0.004*	76.46	7.73	84.44	14.34	293	0.01*
VLF Power (ms ²)	725.36	642.80	632.13	859.69	403	0.275	1576.32	2160,91	892.97	962.45	335	0.04*
LF/HF Power (ms ²)	6.03	7.15	5.75	5.65	471	0.894	6.56	6.29	8.57	8.08	430	0.48
VLF Power (%)	39.77	22.57	38.65	14.46	450	0.673	48.15	18.91	35.40	13.11	284	0.01*
HF Power (%)	15.63	12.34	17.15	14.44	463	0.805	10.23	7.02	14.11	13.97	443	0.60

frequency waves ($p = 0.04$ and $p = 0.01$) significantly increased, which increased much more in the first group than in the second one.

DISCUSSION

Conducting a single vibroacoustic massage session led to a significant improvement in many physical and psychological well-being parameters. Significant favorable changes in the psycho-emotional background state were noted. This was manifested in an improvement in well-being, activity, and mood according to the WAM test. However, in the «mood» cluster, the changes were unreliable [62-64]. Screening

in the Zung test showed a significant decrease in the depression level, and the results of assessing the anxiety state on the Spielberg-Khanin scale indicate a decrease in both personal and situational anxiety. Thus, the mental sphere state after a single session of massage by singing bowls has improved significantly as a whole. Hemodynamic parameters (HR, OMV, and BFEC) and VIK after the procedure changed markedly in both groups ($p < 0.05$ for all parameters). To determine the severity of differences in the dynamics of the indicators between groups, we compared the amplitudes of changes in parameters between groups (Δ). Despite the fact that most indicators had a large amplitude of changes for the first group, for the Δ VIK

parameter in the first group, the changes were less than in the second one [65, 66].

Thus, in the first group, a lesser increase in the parasympathetic nervous system influence was determined compared to the second one. The minute volume of blood flow and HR in the first group decreased more, and it leads to a decrease in the load on the heart. A decrease in BFEC in both groups (but more in the first) indicates a decrease in the difference between systolic and diastolic blood pressure and a decrease in sympathetic influences in the autonomic nervous system. The severity of these changes for men turned out to be much stronger than for women, which is probably due to the greater nervous system lability in women, who reacted less calmly to the new procedure. However, a comparison of these changes amplitude did not reveal significant differences between men and women. The reason for this may be that the subjects first encountered an unusual procedure for vibroacoustic exposure to singing bowls, and it did not allow them to achieve the necessary relaxation.

Changes in the heart rate variability parameters between the groups turned out to be similar in direction. In particular, there was a decrease in the TINN value in the horizontal position and its increase under orthostatic loading after the procedure. Triangular index RR, correlated with sympathetic effects, changed similarly. Such dynamics, most likely, are evidenced by adaptation to environmental conditions, reflecting a decrease in sympathetic regulation at rest and its enhancement during orthostatic load. At the same time, there is an increase in parasympathetic markers RMSSD, NN50 pNN50, mainly in the horizontal position, and the amplitude of these changes is greater for the first group (Table 4). Thus, the adaptive processes improve in both groups, but they are more pronounced in the first group. Additional confirmation of the revealed tendency is the increase in the power of HF waves after the procedure of vibroacoustic massage in the first group, reflecting mainly parasympathetic influences. Intergroup comparisons of HRV parameters before and after the procedure showed that even before the procedure, there were differences between the groups in the parameters LF/HF, HF, Mean RR, and Mean HR (Table 5). However, the differences in Mean RR and Mean HR levels are apparently unrelated to the procedure's protocol since the values changed unidirectionally, and the differences persisted after the procedure. Higher LF/HF levels and lower HF values in

the supine position in the first group compared to the second one before the procedure indicate higher background sympathetic influences in the first group. However, after the procedure, these differences were smoothed out mainly due to changes in the first group, which reflects an increase in the contribution of parasympathetic influences at rest and normalization of the sympathetic-vagal balance. At the same time, during the orthostatic test, a tendency towards a decrease in HF power was observed, which was more pronounced in the first group.

We consider a significant increase in the power of VLF waves in the first group compared to the second one during the orthostatic loading performance as the main change associated with the procedures. The power of VLF oscillations is associated with the influence of neuro-humoral regulation mechanisms and the rennin-angiotensin-aldosterone system, which form circadian rhythms and cortisol release peaks [67-69]. Vibroacoustic massage can increase the activity of the body's adaptive response to stress.

CONCLUSIONS

The study of the vibroacoustic massage using singing bowls effects demonstrated that this technique could exert a variety of effects on a person's psychological characteristics and physiological parameters. We have reliably established that with a single exposure by bowls, such indicators as the state of health, activity, and an increase in the level of personal and situational anxiety improve, which indicates a decrease in neurotization degree. Analysis of hemodynamic changes showed that additional effects are associated with a decrease in the load on the heart and an increase in parasympathetic influences. Nevertheless, the amplitude of these changes for Δ VIK was less in the first group, and this may be due to the lack of experience with vibroacoustic massage in the past in these subjects. Changes in hemodynamic indicators in women were lower than in men, but no significant differences in the amplitude of changes were found. Due to the procedural protocol when measured under orthostatic loading, the main difference between the groups is a significant increase in the power of very low frequencies associated with the operation of adaptive mechanisms. Thus, we can conclude that the author's method of vibroacoustic massage using singing bowls is a promising wellness procedure, although its effects need to be tested in a broader population.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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