ORIGINAL RESEARCH

Effects of Heart Rate Variability (HRV) Biofeedback for Women Undergoing First-time In Vitro Fertilization and Embryo Transfer

Yahui Bian, MM; Fang Liu, MM; Yumei Wang, MD; Xinxue Wang, MM; Ran Chen, MM

ABSTRACT

Context • Patients receiving in vitro fertilization and embryo transfer (IVF-ET) treatments can be anxious and depressed and have other negative emotions. Psychological interventions might improve the clinical pregnancy rate of infertile patients. Heart rate variability (HRV) biofeedback can be an effective technique to treat anxiety and stress symptoms.

Objective • The study intended to investigate the effects and clinical outcomes of HRV biofeedback for women undergoing in vitro fertilization-embryo transfer (IVF-ET) for the first time.

Design • The research team performed a prospective randomized controlled study.

Setting • The study took place at the Reproduction Center of the First Affiliated Hospital of Hebei Medical University in Shijiazhuang, Hebei, China.

Participants • Participants were 60 women who received IVF-ET for the first time at the hospital between January 2015 and December 2017.

Intervention • Participants were randomly divided into the intervention group (n = 30), who received HRV biofeedback, and the control group, who received routine education (n = 30).

Outcome Measures • At baseline and postintervention, the research team analyzed outcomes using: (1) the scores from a self-rating anxiety scale (SAS) and a self-rating depression scale (SDS); (2) HRV indexes, including the standard deviation of normal to normal (SDNN), root mean square of successive differences (RMSSD), percentage of successive R-R intervals that differ by more than 50 milliseconds (PNN50), total power (TP), low frequency (LF), high frequency (HF), and rate of LF and HF (LF/HF); and (3) pregnancy rates.

Results • The control group's SAS scores were significantly higher postintervention, at 48.63 ± 4.75, than those of the intervention group, at 39.23 ± 7.60 (*P* = .000). The control group's SDS scores, at 53.07 ± 3.89, were also significantly higher postintervention than those of the intervention group, at 41.40 ± 9.60 (*P* = .000). For the intervention group, between baseline and postintervention four of the HRV indexes significantly increased: (1) SDNN—from 53.67 ± 9.03 to 79.57 ± 20.48 (p=0.000), (2) RMSSD—from 54.97 ± 13.94 to. 83.74 ± 34.40 (*P* = .000), (5) PNN50—15.04 ± 6.06 to 22.92 ± 9.90 (*P* = .001) and (4) TP—from 851.32 ± 486.47 to 1579.59 ± 746.86 (*P* = .000). The clinical pregnancy rate in the intervention group was higher than that in the control group but the difference wasn't statistically significant, at 60.00% and 46.67%, respectively (*P* = .438).

Conclusions • HRV biofeedback treatment significantly increased four HRV indexes and decreased the anxiety and depression of women undergoing IVF-ET for the first time, showing a potential clinical application. (*Altern Ther Health Med.* 2023;29(2):162-167)

Yahui Bian, MM; Fang Liu, MM; and **Xinxue Wang, MM;** Reproduction Center, the First Affiliated Hospital of Hebei Medical University, Shijiazhuang, Hebei, China. **Yumei Wang, MD;** and **Ran Chen, MM;** Center for Psychiatry, the First Affiliated Hospital of Hebei Medical University, Shijiazhuang, Hebei, China.

Corresponding author: Yahui Bian, MM
E-mail: 1057076160@qq.com

With changes in people's lifestyles, worsening environmental conditions, and increasing pressures on body and spirit, the incidence rate of infertility has been gradually increasing.[1] Infertility has caused many families distress and pain, affecting between 8% and 12% of people worldwide, which makes it a global medical and sociological problem.[2]

In vitro fertilization and embryo transfer (IVF-ET) are two of the most important assisted reproductive technologies that can help infertile women.[3] That technology is becoming mature, but many issues still need to be solved. During treatment, patients not only bear stress from the infertility itself, but the condition can also create pressure in marriages. When patients receive a long-term treatment, they spend a lot of money and energy, can feel uncertain about treatment results, and may experience ovarian hyperstimulation syndrome and other postoperative complications.[15]

Also, in China, the traditional concept of marriage and childbirth includes the idea that a couple can have a perfect marriage only with their own children. If women have fertility problems, they can be under great psychological pressure from their families and society. That great mental pressure can lead to long-term stress. Damti et al found that patients receiving infertility treatments can be anxious and depressed and have other negative emotions.[4] Medical staff in reproductive centers have an obligation to provide psychological support to patients to reduce those negative emotions.

Neuroendocrine and other hormones may affect the outcomes of assisted pregnancy without reasonable external intervention and self-regulation.[5] Wischmann et al found that a psychological intervention for patients experiencing assisted reproductive technology can help to alleviate their negative emotions and have positive effects on pregnancy outcomes.[16] Callesen et al found a correlation between good pregnancy outcomes and good mental health.[18] Ying et al found that a positive psychological intervention can improve the clinical pregnancy rate of infertile patients.[19] Infertile women urgently need an effective external intervention.

The results on whether a psychological intervention can improve the pregnancy rate for IVF-ET, however, aren't consistent. Sun et al reported that the pregnancy rate didn't significantly change in patients treated with IVF-ET for the first time.[20]

Heart Rate Variability (HRV) Biofeedback

The negative emotions that stress causes are closely related to the activity of the autonomic nervous system. An emotional response accompanies changes in autonomic nerve function, including sympathetic and parasympathetic nerves. Biofeedback treatment can make patients intuitively feel their own physical and psychological activities. Through repeated relaxation training, they can achieve a natural relaxation state, thus reducing their negative emotions and improving their condition. Zhou et al found that biofeedback therapy can significantly decrease the negative feelings of patients.[17]

HRV biofeedback is a simple and effective method to evaluate the balance between the sympathetic and parasympathetic nerves.[6,11] Goessl et al found that HRV biofeedback can be an effective technique to treat anxiety and stress symptoms.[7] In addition, although individual differences exist in self-regulation, HRV can be a biological indicator of self-regulation.[8] Chen et al found that the HRV of infertile patients generally decreases with use of biofeedback.[12]

So far, researchers haven't explored the effects of HRV biofeedback for patients who are receiving IVF-ET for the first time. The current study intended to investigate the effects and clinical outcomes of HRV biofeedback for patients women undergoing IVF-ET for the first time.

METHODS

Participants

The research team performed a prospective randomized controlled study. The study took place at the Reproduction Center of the First Affiliated Hospital of Hebei Medical University in Shijiazhuang, Hebei, China. Potential participants were women who received IVF-ET for the first time at the hospital between January 2015 and December 2017.

Potential participants were included in the study if they: (1) had received a diagnosis of infertility using the diagnostic standard in the ninth edition of *Obstetrics and Gynecology*[9]; (2) were infertile due to female factors only; (3) were receiving IVF-ET for the first time; (4) were older than 21 but younger than 45 years of age; (5) had normal cognition; (6) had an SAS score of more than 50 and an SDS score of more than 53 on their first day of hospitalization.

Potential participants were excluded from the study if they: (1) had severe visual or auditory impairment that would prevent them from receiving treatment with HRV biofeedback; (2) had communication difficulties, dementia, or severe heart, brain, or kidney disease; or (3) had a history of mental illness.

The research team obtained informed consent from all participant. The ethics committee of the hospital approved the study's protocols. The research team conducted the study in compliance with the Declaration of Helsinki.

Procedures

Groups. The research team randomly divided the selected participants into the intervention group, who received HRV biofeedback, and the control group, who received routine education. Randomization was computer generated centrally, and staff who weren't involved in the study randomly assigned participants to the groups. No blinding of participants or researchers occurred in the study.

Outcome measures. At baseline on the first day that participants received an injection of the ovulation-inducing drugs, the research team recorded their demographic and clinical information using a questionnaire that contained questions about age, pregnancy preparation time, income, residence, marriage relationship, level of education, and types of infertility. At the same time, the research team recorded data on the factors influencing participants' pregnancies.

At baseline on participants' first day of hospitalization, both groups completed a self-rating anxiety (SAS) scale and self-rating depression (SDS) scale.[10] Postintervention at 14 days after embryo transfer, both groups completed the SAS and SDS scales again. The research team also measured several HRV indexes at baseline and postintervention to study the clinical outcomes and effects of HRV biofeedback.

Intervention

Control group. Participants in this group received routine education, with the research team: (1) on the first day of treatment, explaining the IVF-ET process and related precautions; (2) on the day of the injection to induce ovulation, informing participants about the injection, preservation methods for ovulation-induction needle, and the precautions taken during ovulation induction; (3) on the day of the injection of human chorionic gonadotropin (HCG), explaining the detailed process and necessary preoperative preparations; and (4) after completion of the process, explaining the precautions and potential postoperative adverse reactions.

Intervention group. In addition to routine education, the intervention group received HRV biofeedback therapy at baseline on the first day of ovulation induction, The doctors briefly explained the treatment's purpose, methods, and key points, so that participants could understand the treatment process. The doctors also provided a comfortable and safe environment, with soft lighting, sound controlled below 40 dB, air-conditioning temperature set at about 24°C, and humidity maintained at 40% to 60%.

A biofeedback therapy device (VISHEE, Nanjing, China,) recorded and preserved the participant's physiological conditions, including electrocardiographic monitory and measurements of skin temperature, respiration, and blood-volume pulsation, and then displayed the information in the form of images. Through conscious changes, the participants could make physiological changes toward the normal index of HRV.

The feedback instrument would show any improvement and affirm and strengthen participants' correct responses and enhance their confidence. Each treatment lasted for 25 minutes, occurring every once at 5 days and the second time at 10 days. During the study, the healthcare providers didn't inform patients participants about the possibility that the HRV treatments could affect the chances of a successful implant.

The biofeedback device is a large-scale device, with the economic cost relatively high for personal purchase, and patients who were still willing to continue treatment after the treatment cycle of 10 days could return to the hospital for additional treatments.

Outcome Measures

Factors influencing pregnancy. These factors included ovarian function, fertilized egg cleavage, endometrial receptivity, number of transferred embryos, grade of transferred embryos, and female factors in IVF-ET treatment, including gamete transport barriers, ovulation disorder and endometriosis.

Anxiety and Depression.. Scoring for both the SAS scale and SDS scale uses four grades, with a total of 20 items. The cut-off value of the SAS scale was 50, and the research team defined anxiety as a score ≥50. The cut-off value of the SDS scale was 53, and the research team defined depression as a score ≥53.

HRV indexes. In the intervention group, the research team recorded the HRV indexes at baseline and postintervention. The HRV indexes include a frequency-domain index and a time-domain index. The frequency domain includes the standard deviation of normal to normal (SDNN), the root mean square of successive differences (RMSSD), and the percentage of successive R-R intervals that differ by more than 50 milliseconds (PNN50). The time domain includes total power (TP), low frequency (LF), high frequency (HF), and rate of LF to HF (LF/HF). The time domain represents the entire active state of the autonomic nervous system. When the body is in an abnormal state, the ability to regulate the autonomic nervous system decreases.

SDNN, PNN50 and RMSSD were significantly increased in the intervention group after biofeedback treatment. This outcome is consistent with the results of previous reports.[13]

SDNN measures the stress function of the autonomic nervous system, and its elevation indicates that the body's ability to regulate internal and external environmental changes, and an increase indicates an enhancement of heart rate variability. An increase in the PNN50 indicates that autonomic-nerve function is improving.[14] An RMSSD increase indicates an enhancement of the activity of the parasympathetic nervous system in IVF-ET patients. TP represents the activity of the entire autonomic nervous system and reflects regulatory ability of the body's autonomic nervous system.

Pregnancy test. Postintervention on day 14 after the embryo transfer, the research team performed an HCG test using participants' serum, and at 28-30 days after embryo

Table 1. Comparison of the Demographic and Clinical Data of the Intervention and Control Groups

	Control Group n = 30 Mean ± SD n (%)	Intervention Group n = 30 Mean ± SD n (%)	F/χ²	*P* value
Age, year	32.30 ± 4.98	32.47 ± 4.64	0.449	.894
Pregnancy preparation time, y	4.57 ± 1.77	4.50 ± 2.05	0.167	.893
Income, yuan			0.444	.801
<2000	7 (23.3)	5 (16.7)		
2000-4000	17 (56.7)	19 (63.3)		
>4000	6 (20.0)	6 (20.0)		
Residence			0.720	.698
Urban	19 (63.3)	20 (66.7%)		
Rural	11 (36.7)	10 (33.3)		
Marriage Relationship			0.092	.955
Sweet	8 (26.7)	7 (23.3)		
Normal	19 (63.3)	20 (66.7)		
Cold	3 (10.0)	3 (10.0)		
Education			0.720	.698
Middle school	6 (20.0)	4 (13.3)		
High school	17 (56.7)	20 (66.7)		
College	7 (23.3)	6 (20.0)		
Infertility Types			0.073	1.000
Primary infertility	20 (66.7)	19 (63.3)		
Secondary infertility	10 (33.3)	11 (36.7)		

Table 2. Comparison of the Factors Influencing Pregnancy for the Intervention and Control Groups

	Control Group n = 30 Mean ± SD n (%)	Intervention Group n = 30 Mean ± SD n (%)	F/χ^2	*P* value
Ovarian Function			0.444	0.801
FSH	7.16 ± 0.41	7.03 ± 0.49	1.158	0.275
E2	41.00 ± 4.76	41.40 ± 4.22	0.752	0.732
AMH	2.97 ± 0.49	2.94 ± 0.60	4.432	0.818
Number of basal follicles	10.57 ± 3.31	10.47 ± 1.22	14.617	0.878
Number of Follicles Obtained	10.87 ± 3.38	10.93 ± 2.91	0.038	0.935
Fertilized Egg Cleavage				
Fertilization rate	81.80 ± 11.08	81.60 ± 9.36	0.476	0.940
Cleavage rate	98.27 ± 2.68	97.93 ± 3.37	1.908	0.673
Endometrial Thickness	9.73 ± 1.31	9.67 ± 1.30	0.006	0.844
Endometrial Receptivity			0.218	1.000
C type	27 (90.0)	28 (93.3)		
A-C type	3 (10.0)	2 (6.7)		
Number of Transferred Embryos			0.218	1.000
2	27 (90.0)	28 (93.3)		
1	3 (10.0)	2 (6.7)		
Grade of Transferred Embryos			0.210	0.701
Grade I	22 (38.6)	20 (34.5)		
Grade II	35 (61.4)	38 (65.5)		
Female Factors in IVF-ET			0.352	0.839
Gamete transport barriers	26 (86.67)	27 (90.0)		
Ovulation disorder	2 (6.7)	2 (6.7)		
Endometriosis	2 (6.7)	1 (3.3)		

Abbreviations: AMH, anti-mullerian hormone; E2, estradiol; FSH, follicle stimulating hormone; IVF-ET, in vitro fertilization-embryo transfer.

transfer, the team performed a B-ultrasound examination. The team diagnosed clinical pregnancy if ultrasonography detected the fetal bud and fetal heartbeat.

Statistical Analysis

The research team analyzed all data statistically using SPSS, version 21.0 (IBM, Chicago, IL). The team: (1) expressed the scores for each factor as means ± standard deviations (SDs), (2) used the Chi-square test for count data, and (3) tested the measurement data using a single-sample *t* test. $P<.05$ indicated statistical significance.

RESULTS

Participants

The study included and analyzed the data of 60 participants, with 30 in the control group and 30 in the intervention group (Table 1). At baseline, no significant differences existed between the groups in demographic or clinical characteristics.

Factors Influencing Pregnancy

At baseline, no significant differences existed between the groups in factors influencing pregnancy (Table 2).

Anxiety and Depression

At baseline, no significant differences existed between the groups in levels of anxiety and depression (Table 3). The intervention group's psychological condition postintervention was significantly better than that of the control group. The control group's SAS scores were significantly higher postintervention, at 48.63 ± 4.75, than those of the intervention group, at 39.23 ± 7.60 ($P=.000$). The control group's SDS scores, at 53.07 ± 3.89, were also significantly higher postintervention than those of the intervention group, at 41.40 ± 9.60 ($P=.000$).

HRV Indexes

Table 4 shows that four of the intervention group's HRV indexes significantly increased between baseline and postintervention: (1) SDNN—from 53.67 ± 9.03 to 79.57 ± 20.48 ($P=.000$), (2) RMSSD—from 54.97 ± 13.94 to. 83.74 ± 34.40 ($P=.000$), (5) PNN50—15.04 ± 6.06 to 22.92 ± 9.90 ($P=.001$), and (4) TP—from 851.32 ± 486.47 to 1579.59 ± 746.86 ($P=.000$). However, three of that group's HRV indexes showed no significant change between baseline and postintervention: (1) LF—from 51.37 ± 16.03 to 53.45 ± 15.54 ($P=.612$), (2) HF—from 48.63 ± 16.03 to 46.56 ± 15.55 ($P=.614$), and (3) LF/HF—from 1.41 ± 1.23 to 1.46 ± 1.05 ($P=.868$).

Table 3. Comparison of the Psychology of the Intervention and Control Groups

	Control Group n = 30 Mean ± SD	Intervention Group n = 30 Mean ± SD	F/χ2	*P* value
Baseline				
SAS	51.30 ± 5.84	50.27 ± 6.19	0.017	.509
SDS	56.80 ± 2.54	57.47 ± 2.81	0.594	.339
Postintervention				
SAS	48.63 ± 4.75	39.23 ± 7.60	5.545	.000[a]
SDS	53.07 ± 3.89	41.40 ± 9.60	17.211	.000[*]

[a]*P* = .000, indicating that the control group's SAS and SDS scores were significantly higher postintervention than those of the intervention group

Abbreviations: SAS, self-rating anxiety scale; SDS, self-rating depression scale.

In the control group, the changes in the HRV indicators between baseline and postintervention were not statistically significant (Table 5).

Pregnancy Rate

Although the clinical pregnancy rate for the intervention group at 60.0% was higher than that of the control group at 46.7% (data not shown), no statistically significant difference existed between the groups (χ^2=1.071, P=.438).

DISCUSSION

In the current study, the SDNN, PNN50, RMSSD, and TP significantly increased in the intervention group after biofeedback treatment. This outcome is consistent with the results of Cai et al's study.[13] Besides, TP was significantly increased in our study.

In the current study, biofeedback treatment and health education both alleviated the anxiety and depression of patients. The intervention group's outcome was significantly better than that of the control group. This showed that the medical practitioners shouldn't limited medical procedure to health education about fertility but also provide psychological interventions for patients to achieve better outcomes.

In the current study, although the clinical pregnancy rate in the intervention group was higher than that of the control group, the difference wasn't statistically significant. This may be due to the small sample size, requiring confirmation by studies with larger sample sizes.

The current study had several limitations. The sample size was small, and the outcomes need to be confirmed by a multicenter, randomized study with a larger sample size. In addition, a future study should include more scale analysis, including a family-functioning scale, which would could help to draw a more convincing conclusion.

Table 4. Comparison of the Changes in the HRV Indexes for the Intervention Group Between Baseline and Postintervention

	Baseline n = 30 Mean ± SD	Postintervention n = 30 Mean ± SD	F/χ^2	*P* value
SDNN	53.67 ± 9.03	79.57 ± 20.48	9.417	.000[a]
RMSSD	54.97 ± 13.94	83.74 ± 34.40	14.479	.000[a]
PNN50	15.04 ± 6.06	22.92 ± 9.90	6.279	.001[a]
TP	851.32 ± 486.47	1579.59 ± 746.86	2.775	.000[a]
LF	51.37 ± 16.03	53.45 ± 15.54	0.009	.612
HF	48.63 ± 16.03	46.56 ± 15.55	0.009	.614
LF/HF	1.41 ± 1.23	1.46 ± 1.05	0.179	.868

[a]*P* = .000, indicating that the intervention group's SDNN, RMSSD, PNN50, and TP significantly increased between baseline and postintervention

Abbreviations: HF, high frequency; HRV, heart rate variability; LF, low frequency; PNN50, percentage of successive R-R intervals that differ by more than 50 milliseconds; RMSSD, root mean square of successive differences; SDNN, standard deviation of normal to normal; TP, total power.

Table 5. Comparison of the Changes in the HRV Indexes for the Control Group Between Baseline and Postintervention

	Baseline n = 30 Mean ± SD	Postintervention n = 30 Mean ± SD	F/χ^2	*P* value
SDNN	59.83 ± 21.435	59.27 ± 21.620	0.341	.736
RMSSD	70.40 ± 29.561	69.83 ± 29.415	-0.137	.891
PNN50	19.323 ± 9.128	19.459 ± 9.352	-0.466	.644
TP	855.385 ± 463.350	853.326 ± 466.394	0.215	.831
LF	51.649 ± 16.192	51.681 ± 15.922	-0.473	.636
HF	47.698 ± 16.796	48.065 ± 17.175	-0.404	.689
LF/HF	1.259 ± 0.639	1.251 ± 0.645	0.646	.523

Abbreviations: HF, high frequency; HRV, heart rate variability; LF, low frequency; PNN50, percentage of successive R-R intervals that differ by more than 50 milliseconds; RMSSD, root mean square of successive differences; SDNN, standard deviation of normal to normal; TP, total power.

CONCLUSIONS

HRV biofeedback treatment significantly increased four HRV indexes and decreased the anxiety and depression of women undergoing IVF-ET for the first time, showing a potential for clinical application.

ACKNOWLEDGMENTS

The Health Commission of Hebei Province (No. 20170475) supported this study.

REFERENCES

1. Vander Borght M, Wyns C. Fertility and infertility: definition and epidemiology. *Clin Biochem*. 2018;62:2-10. doi:10.1016/j.clinbiochem.2018.03.012
2. Inhorn MC, Patrizio P. Infertility around the globe: new thinking on gender, reproductive technologies and global movements in the 21st century. *Hum Reprod Update*. 2015;21(4):411-426. doi:10.1093/humupd/dmv016
3. Johnson M. Human in vitro fertilization and developmental biology: A mutually influential history. *Development*. 2019; 146. 15. Schirmer 3rd DA, Kulkarni AD, Zhang Y, Kawwass JF, Boulet SL, Kissin DM. Ovarian hyperstimulation syndrome after assisted reproductive technologies: Trends, predictors, and pregnancy outcomes. *Fertil Steril*. 2020;114:567-578.
4. Damti OB, Sarid O, Sheiner E, Zilberstein T, Cwikel J. [Stress and distress in infertility among women]. *Harefuah*. 2008;147(3):256-260, 276.
5. Petraglia F, Imperatore A, Challis JR. Neuroendocrine mechanisms in pregnancy and parturition. *Endocr Rev*. 2010;31(6):783-816. doi:10.1210/er.2009-0019
6. Wischmann T, Scherg H, Strowitzki T, Verres R. Psychosocial characteristics of women and men attending infertility counselling. *Hum Reprod*. 2009;24(2):378-385. doi:10.1093/humrep/den401
7. Callesen NF, Secher AL, Cramon P, et al. Mental health in early pregnancy is associated with pregnancy outcome in women with pregestational diabetes. *Diabet Med*. 2015;32(11):1484-1491. doi:10.1111/dme.12777
8. Ying L, Wu LH, Loke AY. The effects of psychosocial interventions on the mental health, pregnancy rates, and marital function of infertile couples undergoing in vitro fertilization: a systematic review. *J Assist Reprod Genet*. 2016;33(6):689-701. doi:10.1007/s10815-016-0690-8
9. Sun H, Qian W, Liu B, et al. Effect of cognitive therapy on related indexes and curative effect of first in vitro fertilization embryo transfer. *Zhongguo Fuyou Baojian*. 2017;32:1268-1270.
10. Zhou L, Gao C, Liu Y, et al. Effects of psychological and behavioral intervention combined with biofeedback training on emotional status and quality of life of patients after coronary artery bypass grafting. *Journal of Nurses Training.* 2018; 33:2117-2120,2129.
11. Berntson GG, Bigger JT Jr, Eckberg DL, et al. Heart rate variability: origins, methods, and interpretive caveats. *Psychophysiology*. 1997;34(6):623-648. doi:10.1111/j.1469-8986.1997.tb02140.x
12. Sgoifo A, Carnevali L, Alfonso ML, Amore M. Autonomic dysfunction and heart rate variability in depression. *Stress*. 2015;18(3):343-352. doi:10.3109/10253890.2015.1045868
13. Goessl VC, Curtiss JE, Hofmann SG. The effect of heart rate variability biofeedback training on stress and anxiety: a meta-analysis. *Psychol Med*. 2017;47(15):2578-2586. doi:10.1017/S0033291717001003
14. Segerstrom SC, Nes LS. Heart rate variability reflects self-regulatory strength, effort, and fatigue. *Psychol Sci*. 2007;18(3):275-281. doi:10.1111/j.1467-9280.2007.01888.x
15. Chen J, Gan X, Hu L. Investigation and analysis of psychological status and heart rate variability in patient with infertility. *Journal of Practical Obstetrics and Gynecology.* 2016;32:346-349.
16. Xie X, Gou W, et al. *Obstetrics and Gynecology.* 9th ed. People's Health Publishing House; 2018.
17. Dunstan DA, Scott N. Norms for Zung's self-rating anxiety scale. *BMC Psychiatry*. 2020;20(1):90. doi:10.1186/s12888-019-2427-6
18. Cai L, Zhou X, Bai X. Effect of biofeedback therapy on autonomic nervous function and heart rate variability in elderly patients with coronary heart disease complicated with anxiety and depression. *Shandong Yiyao*. 2016;56:82-83.
19. Zhyheri B, Manfrini O, Mazzolini M, Pizzi C, Bugiardini R. Heart rate variability today. *Prog Cardiovasc Dis*. 2012;55(3):321-331. doi:10.1016/j.pcad.2012.09.001