Original Article
Effects of Yoga exercise on anxiety and fetus growth in pregnant women with small for gestational age fetus

Chunyu Zhuang[1*], Huiling Shi[2*], Yanping Jia[3], Jiacheng Chen[4], Hui Yang[5], Xiaojing Chen[6]

[1]Department of Children's Health, Haikou Maternal and Child Health Hospital, Haikoi 570203, China; [2]Department of Women's Health, Haikou Maternal and Child Health Hospital, Haikoi 570203, China; [3]Department of Neonatology, Haikou Maternal and Child Health Hospital, Haikoi 570203, China; [4]Department of Hepatobiliary Surgery, Hainan General Hospital, Haikoi 570203, China; [5]Department of Obstetrics and Gynecology, Hainan Hospital of Traditional Chinese Medicine, Haikoi 570203, China; [6]Department of Obstetrics and Gynecology, Haikou Maternal and Child Health Hospital, Haikoi 570203, China. *Equal contributors.

Abstract: Objective: To investigate the effect of yoga on anxiety and fetal weight of pregnant women carrying fetus small for gestational age (SGA). Methods: In this retrospective analysis, a total of 186 pregnant women with SGA fetus in our hospital from January 2015 to December 2017 were enrolled in this study. Among them, 90 patients received routine check-up were included in the control group, and the other 96 patients who had professional yoga exercise were included in the observation group. The differences of anxiety scale scores and fetal weight between the two groups before and after intervention were compared. Results: There was no significant difference in scores of anxiety scale (SAS) between the two groups before intervention. After intervention, the SAS score of pregnant women in intervention group was (46.48±3.79) was significantly lower than that in control group (60.13±4.25). There was also significant difference in fetal growth trajectory between the two groups, with a significant increase of 1021.36 g in the intervention group compared with 795.62 g in the control group (P<0.05). Furthermore, single regression analysis showed that average gestational weeks (r=0.064. P=0.011), yoga exercise (r=0.043, P<0.001), forceps use (r=0.338, P<0.001) and conversion to cesarean section (r=0.431, P<0.001) showed a significant correlation with anxiety and fetus growth in pregnant women carrying SGA fetus. Multiple regression analysis showed that yoga exercise (P<0.001) was selected as independent variables in the multiple regression model of anxiety and fetus growth in pregnant women with SGA fetus. Conclusion: Yoga can effectively reduce the anxiety of pregnant women with small gestational age fetus and good for the growth and development of the fetus.

Keywords: Yoga, pregnant women, small gestational age, anxiety

Introduction

Small-for-gestational age (SGA) refers to fetuses or newborns smaller or less developed than normal for the same baby's sex and gestational age. In recent years, the global incidence of SGA has shown a slow upward trend [1], and the incidence of SGA reported in domestic is about 3.20-6.61% [1-3]. With the development of neonatal critical care medicine, the survival rate of SGA infants is also increasing year by year.

The SGA infants are more prone to neonatal complications such as convulsion, sepsis and necrotizing enteritis as compared with normal gestational age infants due to the restriction of intrauterine development [4-6]. Epidemiological statistical analysis showed that the risk of death in SGA infants was 1.83 times that of non-SGA infants [7]. SGA infants do not reach their genetic growth potential in the maternal uterus, and their birth weight is lower than that of normal infants. The incidence of metabolic syndrome such as cardiovascular disease, type 2 diabetes and hyperlipidemia in adulthood of SGA infants is higher than that of normal gestational age infants [8-10]. In addition, SGA infants also have a relatively slow neural development [11].

Figure 1. Flow chart showing recruitment.

effectively prevent the occurrence of fetal distress in uterus and play a certain role in shortening the course of labor [19]. From the perspective of existing research, most scholars were concerned about the impact of yoga on maternal weight control, delivery process, delivery results, and so on, rather than on the psychological status, especially the anxiety, of pregnant women [20, 21].

Therefore, the aim of this study was to investigate the effect of yoga on anxiety and fetal weight of pregnant women carrying SGA fetus.
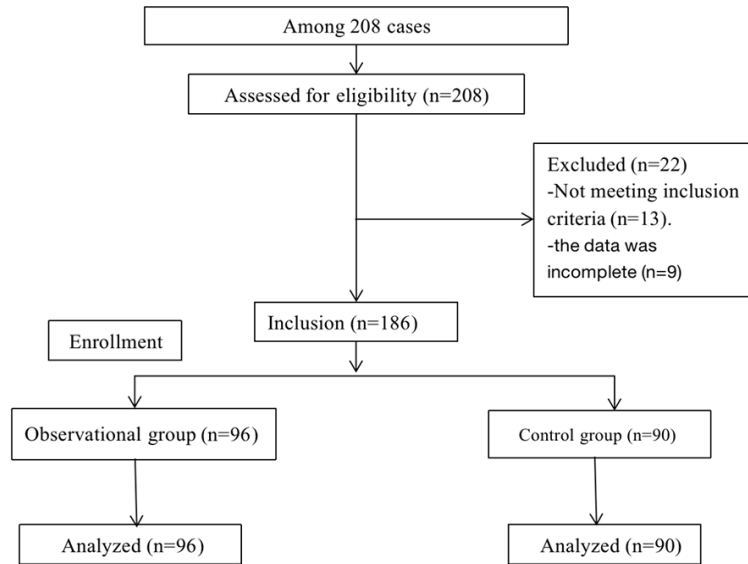
Studies have shown that SGA is an independent risk factor for maternal depression and anxiety of the mothers. In pregnant women carrying SGA fetus, the prevalence of depression can reach 26.8% [12, 13]. Carrying SGA fetus may cause negative emotions such as anxiety, depression and insomnia due to a series of pathophysiological or psychological changes, and may result in adverse pregnancy outcomes, such as preterm birth (<37 weeks gestation) and low birthweight (<2500 g), affecting approximately 10% and 8.3% of pregnancies all over the world, respectively [14]. Enhancing maternal nutrition is a generally accepted treatment [15]. Nutrition during pregnancy is a key determinant of fetal growth and newborn nutritional status, which may increase fetal weight to some extent; however, the incidence of excessive nutrition, cardiovascular disease and insulin non-dependent diabetes are also increased [16]. Therefore, there is still a lack of effective intervention for the depression and anxiety of pregnant women carrying SGA fetus, and whether these adverse conditions would worsen with the aggravation of the disease still needs to be investigated.

As a popular method of exercise decompression, yoga is becoming popular in pregnant women [17]. Studies have shown that yoga exercise has a positive effect on improving the quality of life and interpersonal relationships in pregnant women [18]. Practicing yoga can

Data and methods

Clinical data

In this retrospective study, a total of 186 pregnant women carrying SGA fetus from January 2015 to December 2017 in our hospital were enrolled. Among them, 90 patients received routine check-up were included in the control group, and the other 96 patients had professional yoga exercise were included in the observation group (**Figure 1**). The research was conducted with the approval of Ethics Committee of Haikou Maternal and Child Health Hospital.

Inclusive criteria

(1) Singleton primipara with the gestational weeks more than 28 weeks; (2) Primipara who gave birth to an infant conforming to diagnosis of SGA, as newborns had a birth weight about 10% or two standard deviations lower than the average weight of the infants with same the gestational age; (3) Primipara without a history of smoking and drinking; (4) Primipara with complete clinical data.

Exclusive criteria

(1) Non-primipara; (2) Primipara with incomplete delivery information; (3) Primipara or her immediate family member(s) had a history of mental illness; (4) Primipara who had been hospitalized during pregnancy.

Table 1. Comparison of clinical data between the two groups

	Observational group (n=96)	Control group (n=90)	t/X^2	P
Age (years)	26.73±2.36	26.34±2.42	1.15	0.74
Average gestational weeks	30.05±1.63	31.75±1.64	3.32	0.57
BMI	22.85±1.24	22.45±1.02	1.39	0.28
Surgical history	15 (18.5%)	12 (15.8%)	4.38	0.22
Educational status			0.058	0.971
Bachelor's degree or above	44	42		
Junior college	38	35		
High school and below	14	13		

Methods

The demographic characteristics, past history, fetal ultrasound estimated weight and SDS and SAS scores of the two groups before intervention were collected. The control group received the standard prenatal examination. In addition to the standard prenatal examination, the observation group practiced yoga exercise guided by the yoga instructor for three times per week, one hour each time. Yoga training included postural practice, breathing and meditation. After 8 weeks, the anxiety level and fetal weight gain of pregnant women in the two groups were measured again.

Observation of indicators

<u>*Primary indictors*</u>

Self-rating Anxiety Scale (SAS): The self-rating Anxiety Scale (SAS) was designed and compiled by Zung in 1971 [22]. It is used to measure the degree of individual anxiety. There are 20 items in the scale, of which 5, 9, 13, 17 and 19 items are scored reversely. The scale is scored 1-4 (1 - no or occasionally, 2 - sometimes, 3 - considerable amount of times, and 4 - most or all the time). The higher the standard score, the more serious the individual anxiety.

Self-rating Depression Scale (SDS): The self-rating Depression Scale (SDS) was designed and compiled by Zung in 1965 to measure the degree of individual depression [23]. There are 20 items in the scale, of which 10 items (2, 5, 6, 11, 12, 14, 16, 17, 18 and 20) are scored reversely. The scale is scored 1-4 (1 - no or occasionally, 2 - sometimes, 3 - considerable amount of times, and 4 - most or all the time). The higher the standard score, the more serious the degree of depression.

Fetal weight: The fetal weight was estimated by ultrasound.

<u>*Secondary indicators*</u>

The living quality of the two groups was compared, which was evaluated by SF-36 Scale. The scale contains eight dimensions, including psychological states, emotional role, physical states, body role, pain degree, social functioning, vitality and general health. Each dimension is scored on a scale of 0 to 100 points, with a higher score indicating a better quality of life.

Statistical analysis

SPSS 25.0 was used for statistical analysis. The measurement data were represented by mean ± sd. The inter-group comparison was conducted using independent samples t-test, and the intra-group comparison was conducted using paired t-test. Percentage (%) was used to express enumeration data, and χ^2 test was used for comparison. P<0.05 was considered with significant difference.

Results

Comparison of baseline data

The average age of the participants was 26.42±3.05 years. The average age of the pregnant women in the intervention group was 26.73±2.36 years, with no significant difference (P=0.267). In terms of education level, 46.3% of pregnant women have bachelor's degree or above, 39.5% have college degree, and 14.2% have high school degree or below. There was no significant difference between the two groups (**Table 1**).

Comparison of SAS and SDS between the two groups before and after intervention

Before intervention, the SDS and SAS scores in the observational group were slightly higher than that in the control group, but there was no significant difference (P>0.05). The scores of SDS and SAS were significantly improved in the observational group compared with the control group (P<0.05, **Table 2**), indicating that Yoga exercise could relieve the anxiety and depression of pregnant women.

Table 2. Comparison of SAS and SDS between the two groups before and after intervention (points, $\bar{x} \pm sd$)

	Time	Observational group (n=96)	Control group (n=90)	t	P
SAS	Before intervention	50.13±9.35	49.57±9.65	1.32	0.083
	After intervention	40.54±10.98	48.88±9.26	15.18	0.0002
	t	11.68	1.78	-	-
	P	0.000	0.161	-	-
SDS	Before intervention	54.67±11.33	54.03±10.69	1.24	0.207
	After intervention	42.75±12.49	50.26±13.17	13.22	0.000
	t	8.91	2.917	-	-
	P	0.021	0.068	-	-

Table 3. Comparison of fetal weight gain between the two groups (points, $\bar{x} \pm sd$)

	Observational group (n=96)	Control group (n=90)	t	P Value
Fetal weight gain	1021.36±173.14	795.62±181.25	8.687	<0.001

Comparison of fetal weight gain between the two groups

As shown in the **Table 3**, the fetal weight gain in the control group was 795.62 g, which was significantly lower than 1021.36 g in the observational group (P<0.01).

Comparison of living quality between the two groups

The psychological state, physical state, pain degree, vitality and overall health score in SF-36 scale of observation group were remarkably higher than those of control group (P<0.05), as shown in **Figure 2**.

Comparison of the outcome of delivery between the two groups after labor analgesia

As shown in **Table 4**, the incidence of conversion to cesarean section and forceps use showed significant difference between the two groups (P<0.05). On the other hand, there was no obvious difference between the two groups in terms of the incidence of episiotomy and Neonatal Apgar score (P>0.05).

The correlations of various factors with anxiety and fetus growth in pregnant women

As shown in **Table 5**, average gestational weeks (r=0.064. P=0.011), yoga exercise (r=0.043, P<0.001), forceps use (r=0.338, P<0.001) and conversion to cesarean section (r=0.431, P<0.001) were significantly correlated with anxiety in pregnant women, while the age, BMI, education degree, surgical history, and episiotomy showed no significant correlation with anxiety in pregnant with SGA fetus. In addition, we also analyzed the correlations of various factors with fetus growth in the pregnant women. The results showed that female age (r=-0.304, P=0.001), yoga exercise (r=0.433, P<0.001), BMI (r=-0.246, P=0.008) and average gestational weeks (r=0.231, P=0.013) were significantly correlated with fetus growth in pregnant women, while the education degree, surgical history, forceps use, episiotomy, and conversion to cesarean section showed no significant correlation with fetus growth in pregnancy with SGA fetus (**Table 6**).

Multiple regression analysis

Four variables with P<0.5 (i.e., average gestational weeks, yoga exercise, forceps use, and conversion to cesarean section) in univariate analysis were entered in the multiple regression analysis. Multicollinearity was checked in variables. Yoga exercise (P<0.001) was proved as dependent variable for anxiety and fetus growth in pregnant women carrying SGA fetus (**Table 7**).

Discussion

The results of this study confirmed that yoga can reduce the anxiety of pregnant women with SGA fetus and improve the growth and development of the fetus. Pregnant women carrying SGA fetus are more worried about the health of the fetus than pregnant women carrying normal weight fetus, so they are more anxious. Studies have reported that women with high-risk pregnancy have significantly increased anxiety and fear. Moreover, any complication during pregnancy can aggravate anxiety in pregnant women [24]. However, some studies have found that the anxiety level of pregnant
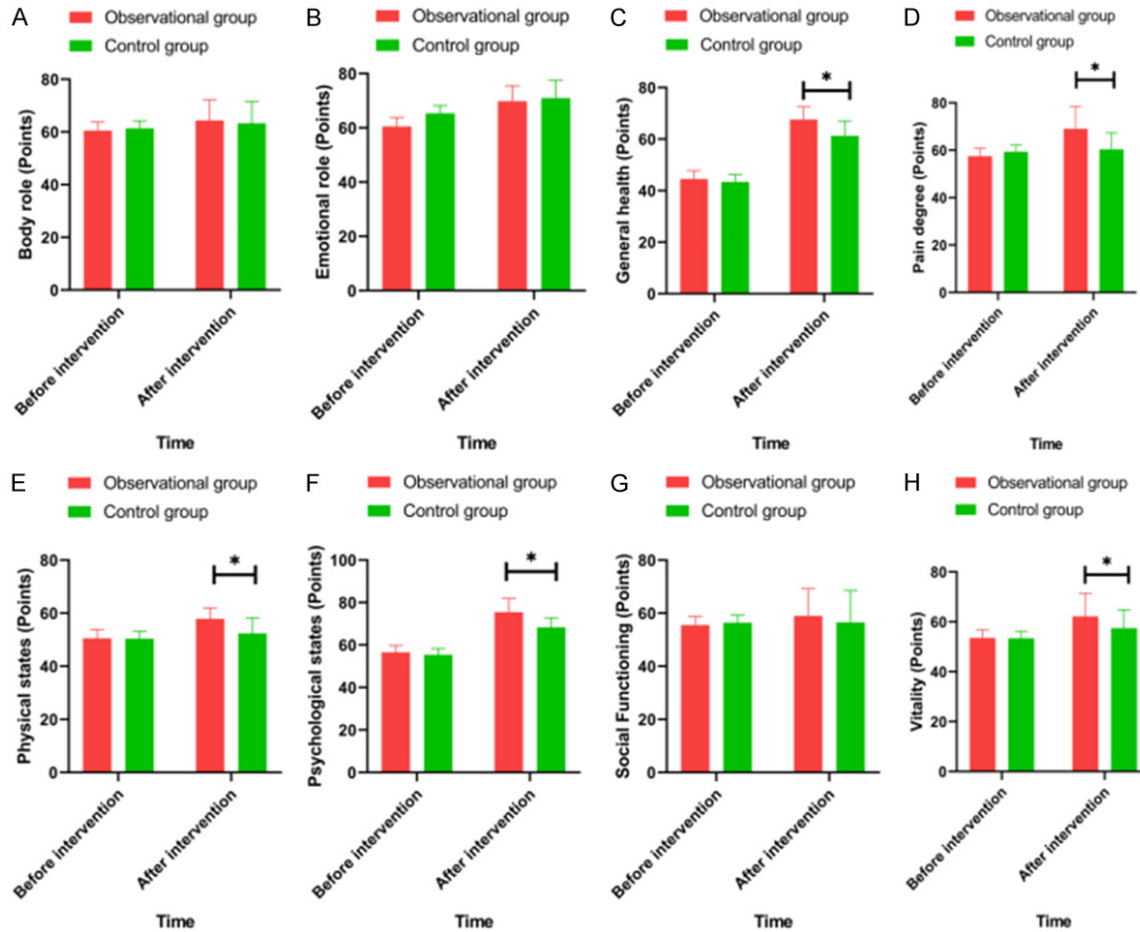
Figure 2. Comparison of quality of life between the two groups. A: Body role; B: Emotional role; C: General health; D: Pain degree; E: Physical states; F: Psychological states; G: Social Functioning; H: Vitality. *P<0.05.

Table 4. Comparison of the outcome of delivery between the two groups after labor analgesia

Group	Number of cases	Conversion to cesarean section	Forceps use	Episiotomy	Neonatal Apgar score	
					1 min after birth	5 min after birth
Observational group	96	1 (1.2%)	10 (9.9%)	18 (18.5%)	9.72±0.13	9.94±0.57
Control group	90	15 (17.1%)	25 (27.6%)	23 (25%)	9.41±0.29	9.74±0.63
X^2	-	4.984	5.783	1.943	2.148	3.349
P	-	0.035	0.004	0.067	0.253	0.136

Note: Compared with the control group, there is significant difference as P<0.05.

women with preeclampsia in early pregnancy screening did not increase [25].

In addition, the research results showed that the anxiety score of the yoga group after the intervention was significantly lower than that before the intervention, indicating that yoga can effectively reduce the anxiety level of pregnant women. After two months of yoga training, the SAS and SDS scores of pregnant women in

observation group was significantly lower than those of the control group. Many studies at home and abroad have developed different methods to reduce the stress and anxiety of pregnant women during pregnancy, such as music therapy, hypnotherapy, muscle relaxation, deep breathing, and anti-anxiety drugs [26-29], and have achieved good decompression effect, which is consistent with the results of this study. In recent years, yoga, as an appro-

Table 5. The correlations between various variables and anxiety in pregnant women

Indexes	rho	P
Age	-0.071	0.454
BMI (kg/m^2)	-0.070	0.461
Average gestational weeks	0.064	0.011
Bachelor's degree or above	-0.032	0.743
Junior college	0.088	0.355
High school and below	-0.070	0.461
Surgical history	0.088	0.355
Yoga exercise	0.431	<0.001
Forceps use	0.338	<0.001
Episiotomy	0.458	0.211
Conversion to cesarean section	0.431	<0.001

Note: The correlation analysis was used for data with normal distribution and Spearman correlation analysis was used for data not conforming to normal distribution.

Table 6. The correlations between various variables and fetus growth in pregnant women

Indexes	rho	P
Age	-0.304	0.001
BMI (kg/m^2)	-0.246	0.008
Average gestational weeks	0.231	0.013
Bachelor's degree or above	0.234	0.052
Junior college	0.100	0.307
High school and below	-0.021	0.833
Surgical history	-0.022	0.821
Yoga exercise	0.433	<0.001
Forceps use	0.044	0.645
Episiotomy	0.066	0.483
Conversion to cesarean section	0.060	0.529

Note: The correlation analysis was used for data with normal distribution and Spearman correlation analysis was used for data not conforming to normal distribution.

priate exercise during pregnancy, has been recognized by many scholars at home and abroad. Satyapriya et al. [30] conducted a prospective experimental research and confirmed that yoga training once a day for 16 weeks can significantly reduce the depression of pregnant women. Battle et al. [31] found that yoga had high acceptability and reduced the degree of prenatal depression of pregnant women. The mechanism was speculated to be that yoga can adjust stress and other emotions by improving the abnormal excitation of the sympathetic adrenal medullary system and hypothalamic pituitary adrenal system (HPA Axis) of pregnant women [31]. Yoga exercise can balance the excitability of sympathetic and parasympathetic nerves, reduce the feeling of stress, and improve the adaptability to pregnancy.

It is worth mentioning that this study innovatively found that yoga can improve the growth and development of the fetus and increase the weight of SGA fetus. However, other decompression methods such as music therapy have similar results. In addition, a meta-analysis also confirmed that music therapy has a positive effect on neonatal weight gain and reducing ICU stay [33].

Interestingly, we observed that the incidence of conversion to cesarean section and forceps use in control group was higher than that in the observation group. Yoga exercise increased the tension and elasticity of abdominal muscles, lumbar muscles and pelvic floor muscles, and added flexibility of joints and ligaments. It is conducive to the vaginal delivery of the fetus [34]. During pregnancy, through professional yoga training such as baby style, pelvic tilt style, lunge style, apana style and hero style, pregnant women can stretch the hips and pelvis, increase the strength of the muscles and elasticity and flexibility of the joints, and improve natural birth rate. In addition, yoga training avoids the slow or stagnant labor process caused by poor muscle strength and reduces the rate of cesarean section [35].

Inevitably, there are still some drawbacks in this study. The sample size included in this study is relatively small, which is a limitation of this study. In the later research, the sample size will be expanded, and the effect of yoga on anxiety and fetal weight of pregnant women with SGA fetus will be investigated, so as to provide a more scientific basis for its extensive clinical application.

In conclusion, yoga can effectively reduce the anxiety of pregnant women with SGA fetus, and it is conducive to the growth and development of the fetus and has a certain clinical value. However, due to the small sample size and relatively short time limit, it still needs to be further confirmed by multi-center and complete randomized controlled studies with large samples.

Table 7. Multiple regression analysis

Dependent variable	Independent variables	B	SE	β	P
Yoga exercise	Anxiety in pregnant	1.288	0.394	0.284	<0.001
	Fetus growth	0.593	0.283	0.188	0.038

Note: B: nonstandard regression coefficient; SE: standard error; β: multiple correlation coefficient adjusted for the degrees of freedom.

Disclosure of conflict of interest

None.

Address correspondence to: Xiaojing Chen, Department of Obstetrics and Gynecology, Haikou Maternal and Child Health Hospital, No. 6 Wentan Road, Haikoi 570203, Hainan, China. Tel: +86-0898-65388212; E-mail: chenxiaojing0430@163.com

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