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ORIGINAL

EFFECTS OF A YOGA PROGRAMME ON PERFORMANCE IN RHYTHMIC GYMNASTICS: A CASE STUDY

EFFECTOS DE UN PROGRAMA DE YOGA EN EL RENDIMIENTO EN GIMNASIA RITMICA: UN ESTUDIO DE CASOS

Sierra-Palmeiro, E.¹; Fernández-Villarino, M.²; Freire-Maceiras, R.³

¹ Profesora Titular. Departamento de Educación Física Deportiva. Facultad de Ciencias del Deporte. Universidad de A Coruña (Spain) elena.sierra@udc.es

² Profesora Contratada Doctor. Departamento de Educación Física Deportiva. Facultad de Ciencias de la Educación y del Deporte. Universidad de Vigo (Spain) marianfv@uvi.es

³ Profesora Asociada. Departamento de Educación Física Deportiva. Facultad de Ciencias de la Educación y del Deporte. Universidad de Vigo (Spain) rfreire@uvi.es

Spanish-English translator: Karen Marie Willson, Interlingua Traduccions, S.L., rosacamina@mundo-r.com

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ABSTRACT

Rhythmic Gymnastics is a sport that requires high-difficulty motor skills and perfect execution. The body is considered as a yoga and mind therapy that for many researchers influences the improvement of sports performance. In this work we analyze the effect of a Yoga training on sports performance and the psychological variables related to it. Thirty gymnasts between the ages of 11 and 16 participated, doing a weekly Yoga session for 5 months, in addition to the Rhythmic Gymnastics training. We analyze the changes in performance and in the psychological variables studied before and after the intervention. The results obtained indicate a significant improvement in both parameters.

Conclusions: the gymnasts participating in our study significantly improve their

performance after the intervention, which may suggest, without generalizing, the advantages of including a yoga exercise program in their preparation.

KEY WORDS Rhythmic gymnastics, yoga, psychological skills, sports performance

RESUMEN

La Gimnasia Rítmica es un deporte que exige habilidades motoras de alto nivel de dificultad y una perfecta ejecución. El yoga es considerado como una terapia de cuerpo y mente que para muchos investigadores influye en la mejora del rendimiento deportivo. En este trabajo analizamos el efecto de un entrenamiento de Yoga sobre el rendimiento deportivo y las variables psicológicas relacionadas con éste. Participaron 30 gimnastas entre 11 y 16 años que realizaron una sesión de Yoga semanal durante 5 meses, además del entrenamiento de Gimnasia Rítmica. Analizamos los cambios en el rendimiento y en las variables psicológicas estudiadas antes y después de la intervención. Los resultados obtenidos indican una mejora significativa de ambos parámetros. Conclusiones: las gimnastas participantes en nuestro estudio mejoran significativamente el rendimiento después de la intervención, lo que puede sugerir, sin poder generalizar, las ventajas de incluir programas de ejercicios de yoga en su preparación.

PALABRAS CLAVE Gimnasia Rítmica, yoga, habilidades psicológicas, rendimiento deportivo.

1. INTRODUCTION

Rhythmic Gymnastics is a sport characterised by the ability to perform very complex motor skills and the high difficulty level of body and apparatus movements performed during a relatively short time (Ávila-Carvalho, 2012). Perfect execution is one of the most decisive factors in sport success in this modality, as any fault is penalised by the Code of Points (FIG, 2017). This requires gymnasts to maintain high levels of concentration and strictly control their anxiety, in order to achieve the maximum level of execution performance in a short period of time (Pulido, Fuentes y de la Vega 2021).

Yoga is an ancient science and a physical art form associated with a set of principles and practices designed to promote health and wellness through integrating body, breathing and mind. Its components include asanas (physical postures), pranayama (voluntarily regulated breathing) and dhyana (meditation). Many authors claim it can increase capacity to focus, improve cognitive ability (Gothe, Pontifex, Hilman et al., 2013, Luu and Hall, 2016), decrease stress and increase and strengthen the organ system and the flexibility of the nervous system, reduce perceived stress and boost overall self-efficacy (Streeter et al., 2010; Need, Hartfield et al., 2011; Mohammad, Thakur, Kumar et al., 2019; Hewett, Pumphrey, Smith et al., 2019).

In a review of 81 studies that compared yoga with other kinds of physical exercise (walking, running, cycling), Ross and Thomas (2010) found that yoga was equally or more effective in improving multiple factors associated with wellness. Yoga has also been associated with improved mental health. These positive influences include reduced anxiety (Subramanya and Telles, 2009; Szabo, Nikhazy, Tihanyi et al., 2017), stress (Gaskins, Jennings, Thind et al., 2014) and increased motivation (Donohue, Miller, Beisecker et al., 2006). Although there is less published research on young people, the emerging findings are similar to those for adults (Galantino, Galbavy and Quinn, 2008; Kaley-Isley, Peterson, Fischer et al., 2010; Conboy, Noogle, Yook et al., 2017). Ortiz Torres et al. (2021), in a study on Chilean schoolchildren, concluded that a short yoga session can significantly reduce stress levels.

Compared to contemplative practices that lack physical activity (body scanning, meditation), yoga has been found by some studies to be more effective in increasing attention control and reducing perceived stress and anxiety (Carmody and Baer, 2008).

Practising yoga also improves physical qualities such as flexibility and agility (Kaur and Bal, 2009), strength and force control (Hart and Tracy, 2008), boosts cardiorespiratory performance (Harinath, Malhotra, Pal et al., 2004) and reaction time (Blaschka, Rath and Tetens, 2019) or physical function and employment (Greysen, Hong and Katz, 2019). Regular hatha yoga training (the yoga practised in the West) lowered blood pressure and heart rate, improved respiratory functions, decreased blood glucose levels, and boosted functional fitness and self-perceived quality of life (Grabara, 2017). Ritchder, Tietjens, Ziereis et al. (2017) studied the effects of yoga training on motor and executive function in primary school children, finding significant improvements after the programme similar to those seen in conventional training. Galan, Irina, Zoriy et al. (2019) observed improvements in motor skills (balance, strength and flexibility) in school children.

Several researchers have analysed the role yoga can play in improving performance in certain sports, integrating yoga into a holistic approach to training to foster a relaxed state of concentration and greater body awareness: Goodman, Kashdan, Fallon et al. (2014), Donohue, Miller, Baisecker et al. (2006) in athletics, and Briegel-Jones, Knowles, Eubank et al. (2013) in basketball and swimming.

The aim of this study is to analyse the effect of a sports training programme that integrates yoga exercises on performance-related psychological characteristics in Rhythmic Gymnastics: stress management, influence of performance appraisal, motivation, mental ability and team cohesion (Gimeno 2010), and on sport performance in competitions.

MATERIAL AND METHOD

Our report takes the form of a case study, given that the sample used is small.

SAMPLE**Table 1.** Overview gymnast

		Mean±SD
Years		13,20±1,91
Years practicing rhythmic gymnastics		6,73±2,66
Weight		48,1±7,22
Height		163±5,12
Modality	Individual	n:10
	Group	n: 20

Note: SD= Standard Deviation; n: number of gymnasts.

The participants were 30 female gymnasts, aged between 11 and 16, who met the following inclusion criteria: they compete in national RG competitions, do not practice any sport other than RG, and have spent at least 4 years practising RG. The gymnasts trained 6 days a week for an average of 20 hours weekly.

PROGRAMME

The programme lasted 5 months, from January to May, in the pre-competitive and competitive period. The gymnasts carried out a weekly session of hatha yoga lasting 60 to 90 minutes and guided by a qualified instructor who integrated pranayama (breathing techniques), dhyana (meditation) and asanas (postures). In addition, on a weekly basis, the gymnasts included postures they had practised in their warm-ups and did 20 minutes of breath control work at home every week.

PROCEDURE

For the psychological appraisal of the gymnasts, we used the Questionnaire of Psychological Characteristics Related to Sports Performance (CPRD) created by Gimeno, Buceta and Pérez-Llantada (2001). This questionnaire consists of 55 items divided into five measurements: stress management, influence of performance appraisal, motivation, mental ability and team cohesion. This questionnaire was used because it is a tool that offers psychometric guarantees and its measurements allow for a comprehensive psychological appraisal of the athlete (Gimeno, Buceta and Pérez-Llantada 2007). This tool was given to the gymnasts before starting and after finishing the programme.

The scores obtained by the gymnasts in two official competitions, one before the programme and the other after the programme, were used to assess their performance. Four values obtained in each competition were used: body difficulty, apparatus difficulty, performance score and the overall score, which is the result of the sum of the partial scores.

STATISTICAL ANALYSIS

We carried out a descriptive analysis for the CPRD variables of the total scores for every factor of the questionnaire and for each of the 55 items that form part of it and the variables that depend on the scores obtained in the competitions, before and after the programme. To analyse the relationship between pre- and post-programme outcomes, we used the T-test and ANOVA at a significance level of $p < 0.05$. Pearson's correlation coefficient (r) was used to analyse possible associations between quantitative variables. Student's T-Test was used to calculate the effect on the dependent variables.

ETHICAL ASPECTS

All members of the sample participated voluntarily, being informed beforehand of the purpose of the study and the type of training they would be doing. Informed consent was requested from the legal guardians of the gymnasts. The confidentiality of the information collected in the study was guaranteed in accordance with current law, anonymising the registration sheets and questionnaires for data processing and dissemination of the results. The study was carried out following the Ethical Standards in Sport and Exercise Science Research (Harris and Atkinson, 2015).

RESULTS

Before and after results (Table 2) indicate that our gymnasts significantly improved their scores in all five psychological variables after the programme.

Table 2. Scores of the CPRD variables before and after the intervention.

	PRE-INTERVENTION		POST-INTERVENTION		t
	Mean $\pm$ DS	Per		Per	
STRESS CONTROL	45.33 $\pm$ 8,31	45	57.43 $\pm$ 5,26	75	-8.12**
PERFORMANCE EVALUATION	25.3 $\pm$ 5,29	50	35.03 $\pm$ 4,02	90	-8.80**
MOTIVATION	23.97 $\pm$ 3,00	80	26.33 $\pm$ 2,65	90	-3.80**
MENTAL ABILITY	23.97 $\pm$ 2,82	80	26.73 $\pm$ 2,97	90	-4.19**
GROUP COHESION	20.53 $\pm$ 2,09	65	22.60 $\pm$ 2,12	85	-4.42**

Note: SD: Estandar Deviation. Per: Percentile. *Significance $p \leq 0.05$, **Significance $p \leq 0.005$

If we compare the scores of the CPRD, depending on the modality (individual or group) before the programme, we observe differences in all the variables, but they are only significant for the team cohesion variable.

After the programme, the differences were significant in performance appraisal, motivation and team cohesion (Table 3), as we found greater improvement in these psychological skills in the group gymnasts.

Table 3. Scores of the CPRD variables before and after the intervention according to the modality.

	PRE-INTERVENTION					POST-INTERVENTION				
	INDIVIDUAL		GROUP		F	INDIVIDUAL		GROUP		F
	n: 10		n: 20			n: 10		n: 20		
	Mean	Per	Mean	Per		Mean	Per	Mean	Per	
STRESS CONTROL	46.80	50	44.60	45	0.458	55.60	70	58.35	80	1.850
PER. EVALUATION	27.00	65	24.45	50	1.574	32.90	80	37.60	90	12.181**
MOTIVATION	24.90	80	23.50	80	1.476	24.60	80	27.20	95	7.906**
MENTAL ABILITY	23.90	70	24.00	80	0.012	28.10	95	26.05	90	3.443
GROUP COHESION	20.00	45	21.60	75	4.329*	22.05	85	23.70	90	4.495*

Note: n: number of gymnasts, Per: Percentile. *Significance $p \leq 0.05$, **Significance $p \leq 0.005$

The results related to the performance of the gymnasts in the competition show a significant improvement on the four performance elements assessed (table 4).

Table 4. Scores of the variables related to performance before and after the intervention.

	PRE-INTERVENTION	POST-INTERVENTION	t
	Mean $\pm$ SD	Mean $\pm$ SD	
SCORE BD	2.32 $\pm$ 0.83	2.56 $\pm$ 0.75	-4.727**
SCORE AD	3.15 $\pm$ 1.85	3.73 $\pm$ 1.38	-2.832**
SCORE E	3.23 $\pm$ 2.48	4.06 $\pm$ 1.04	-1.920*
TOTAL SCORE	8.35 $\pm$ 3.60	10.2 $\pm$ 2.63	-7.434**

Note: Body Difficulty (BD), Apparatus Difficulty (AD), Execution (E). **Significance $p \leq 0.05$; *Significance $p \leq 0.005$

We also calculated the effect of the variables related to performance in competition before and after the programme. The results indicate that the effect size is significant and medium-sized for the total scores, T of $T = 0.6140$ ($p = 0.016$), and is only significant and lower in the partial scores for the Execution Score, T of $T = 0.4588$ ($p = 0.078$).

The analysis of the correlations between the scores of the CPRD and competition performance before the programme was not significant for any variables, and after the programme, the relationship between the variable Performance Evaluation and Performance Score was negative and significant ($r = -0.398$ $p > 0.05$).

We also analysed the correlations between the variables obtained by calculating the difference in scores on each of the items of the CPRD questionnaire and the difference between each performance score, before and after the programme. The result was only significant for the difference between items 18, 21, 23, 27, 32 and 54 and not for all performance variable differences (table 5 and 6).

Table 5. Results Pearson's correlation between the difference in scores on items of the CPRD questionnaire, and between each of the performance-related scores, before and after the intervention.

<i>r</i>	Score Difference BD	Score Difference AD	Score Difference E	Score Difference TOTAL
Difference Item 18	0.211	0.501*	-0.185	.007
Difference Item 21	-0.400*	-0.087	0.126	-0.339
Difference Item 23	0.092	0.377*	-0.085	-0.114
Difference Item 27	0.077	0.079	-0.030	0.423*
Difference Item 32	-0.295	-0.077	0.389*	0.021
Difference Item 54	-0.387*	-0.222	-0.167	-0.173

Note: *r*: Pearson's correlation; Body difficult (BD), Apparatus Difficult (AD), Execution (E). ** Significance $p \leq 0.05$; * Significance $p \leq 0.005$

Table 6. Scores of the CPRD items before (Pre) and after (Post) the intervention that significantly correlate with differences in score relative to performance.

ITEM	PRE M $\pm$ SD	POST M $\pm$ SD	t
18. I like to work as a team with my colleagues	3.83 $\pm$ 0.461	3.97 $\pm$ 0.183	-1.439
21. When I start doing it wrong my confidence drops quickly	2.20 $\pm$ 1.095	3.00 $\pm$ 0.871	-4.00**
23. When I practice mentally, I see myself doing it as if I were watching myself on a TV monitor	2.10 $\pm$ 1.373	2.40 $\pm$ 1.192	-0.758
27. When my team loses, I feel bad regardless of my individual performance	2.63 $\pm$ 1.245	3.13 $\pm$ 0.937	-1.851*
32. I trust myself	2.83 $\pm$ 1.11	3.17 $\pm$ 0.986	-1.471
54. I usually trust myself even in the most difficult moments of a competition	3.00 $\pm$ 0.871	3.53 $\pm$ 0.681	-2.719*

Note: PRE: Pre-intervention, POST: Post-Intervention. M: mean, SD: Standard Deviation.

*Significance $p \leq 0.05$, **Significance $p \leq 0.005$

DISCUSSION

Knowledge, study and research of the psychological values present in sport performance can contribute towards athletes having a more holistic training process and optimising their performance, thus increasing their possibilities of achieving better sporting results (Robles et al., 2019).

The results of the analysis of the pre-programme psychological variables obtained in the CPRD are very similar in our gymnasts to those provided for the control group of the CPRD questionnaire (Gimeno et al., 2001), except for the stress control variable where our gymnasts obtained slightly lower scores. In contrast, they scored higher on all variables; when compared to the data from Carmona, Jaenes and Lopa (2010) in their study on 89 gymnasts aged between 8 and 17, the differences found could be attributed to the sporting level of the gymnasts.

We can find the lowest pre-test values in stress control variables compared to other athletes such as judokas (Gimeno et al., 2001), handball players (Olmedilla, Ortega, Garcés de los Fallos et al., 2015) basketball players

(Olmedilla, Ortega and García-Mas (2017), (Lorenzo, Gómez, Pujals et al., 2012) or junior tennis players (Sánchez-Alcaraz 2013) and in general higher values in motivation and team cohesion. Maybe the vocational character seen in RG from early ages justifies these results.

In a recent study (Arias, Cardoso, Aguirre et. al., 2016) on the application of the CPRD to various sports (football, five-a-side football, volleyball and basketball), significant differences were found between the sports disciplines, which may imply a psychological behaviour specific to the sport modality in question, as well as significant differences between women and men, with women obtaining better results in mental ability, motivation and team cohesion. Our results are consistent with these studies taking gender into account. Andrade-Sánchez, Galindo-Vilardon and Cuevas (2015) also observed differences in terms of gender as men seemed to have greater control of stress and motivation. Another study carried out on judokas (Pulido et al., 2021) found higher levels of anxiety in women than in men, which could condition their performance in competitions. This study also showed that the scores on the stress control and team cohesion variables were visibly lower in those playing an individual sport. Our previous results indicate significant differences in the team cohesion variable, which is higher in group gymnasts, similar to team sports, compared to the individual gymnasts, similar to individual sports.

The results of our sample were significantly better in all CPRD variables after integrating yoga exercises into training. This is in line with other studies that worked with different methodologies on psychological aspects. Olmedilla, Ortega, Andreu et al., (2010) found, after a psychological intervention programme with a group of football players with similar ages, that the measurements obtained afterwards were higher in three factors (Stress Management, Performance Appraisal Influence and Mental Ability), and lower in two of them (Motivation and Team Cohesion) but there were no statistically significant differences in any of the factors. A study similar to ours, carried out by Goodman, Kashdan, Mallard et al., (2014), with a 5-week programme combining yoga and mindfulness for NCAA men's track and field athletes, showed improvements in attention, greater goal-directed energy and less perceived stress than before the programme.

The results in terms of performance of the gymnasts after the programme showed a statistically significant improvement in all scoring domains. The size of the effect indicates a significant mean value and reinforces these results. Several studies support the improvement of some conditional parameters after performing yoga exercises. Brynzak and Burko (2013) found that yoga exercises directly influence all indicators of basketball players' training, especially in terms of flexibility and balance. Gothe, Pontifex, Hillman et al. (2013), in a study on women, noted improvements in reaction time and in memory after yoga exercises compared to aerobic exercises, possibly due to an anxiety-reducing and attention-enhancing effect. Other authors (Pisarra, Boleto and Ramos 2020) indicate that women seem to reap more benefits from yoga practice than men.

Donohue et al. (2006), with a yoga exercise programme for long distance runners, found significant improvements over the control group in running performance for the mile race. Ritchder, Tietjens, Ziereis et al. (2016) studied the effects of yoga training on executive motor function in primary school children, finding significant improvements after the programme similar to those found in conventional training.

Kaufman, Glass and Arnkoff (2009) assessed sport performance after brief mental training, *Mindful Sport Performance Enhancement* (MSPE), which integrates yoga techniques, and found improvements in sports performance and certain psychological characteristics related to the performance of archers and golfers that require a high degree of mental concentration and fine motor movements in much the same way as RG. Another similar study monitoring archers, golf players and runners (Thompson, Kaufman, De Petrillo et al., 2013) suggests that a programme of this type can improve sport performance.

Briegel-Jones et al. (2013) found a positive impact in cognitive, physiological and performance aspects after a 10-week programme with elite swimmers. Bendo and Haxholii (2017) found significant improvements in balance after 3 months' yoga exercise training.

In general, our results coincide with those found in most physical performance indicators, although we cannot determine the percentage of improvement attributable to training or yoga practice because of the absence of a control group.

Of note is the significant negative correlation found between the Performance Evaluation (PE) and the Execution Score. The PE scale measures the athlete's response to situations in which he/she is being assessed by other relevant people. RG is a sport in which the final result is determined by a jury's score, and the correlation is most likely explained by the gymnasts' concern about the possible impact of their performance on the judges, and therefore on their score. The correlation between the differences in the scores of each item and performance variables before and after the programme gives us positive results in only six items, which are related to teamwork and self-confidence. This could indicate the importance of both psychological parameters in the improvement of performance in competition.

This could suggest that in RG, these psychological variables determine performance, which would require more specific studies to determine the percentage of each of the psychological components involved in the final result in a competition.

CONCLUSIONS

In this work we studied the performance level of a group of gymnasts in terms of the psychological variables that directly affect their performance before and after a 5-month yoga exercise programme

The pre-test results indicate a small deficit in the stress control variable with regard to samples from yoga and other sports. A significant improvement can be seen in the study group in all variables analysed after the programme, in particular in terms of stress control.

Regarding competition performance, a significant improvement was obtained after the programme in the performance of the gymnasts under study, but it is not possible to discern what percentage of this improvement is due to the performance of the exercises.

Without making any general statements, given the low sample size of this study, the results obtained with this gymnastics group indicate that including a programme of yoga exercises in the preparation of gymnasts in the run-up to a competition could be beneficial.

In order to better understand and apply these results, we suggest a study that includes a control group and a larger sample size encompassing gymnasts from other levels.

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