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Zuzanna Piekorz¹, Irena Bułatowicz¹, Agnieszka Radzimińska¹, Andrzej Lewandowski², Szymon Piekorz², Grzegorz Grabarczyk², Monika Ciesielska³

THE INFLUENCE OF HATHA YOGA EXERCISE ON ARTERIAL PRESSURE AND PULSE

**WPLYW TRENINGU HATHA JOGI NA WARTOŚCI CIŚNIENIA TĘTNICZEGO
I CZĘSTOŚĆ TĘTNA**

¹Z Katedry i Zakładu Kinezyterapii i Masażu Leczniczego UMK w Toruniu Collegium Medicum
im. L. Rydygiera w Bydgoszczy

p. o. kierownika: dr Irena Bułatowicz

²Z Katedry i Zakładu Podstaw Kultury Fizycznej UMK w Toruniu Collegium Medicum

im. L. Rydygiera w Bydgoszczy

p. o. kierownika: dr Andrzej Lewandowski

³Z Katedry i Kliniki Anestezjologii i Intensywnej Terapii UMK w Toruniu Collegium Medicum

im. L. Rydygiera w Bydgoszczy

kierownik: Dr hab. Krzysztof Kusza, prof. UMK

S u m m a r y

Introduction. Hypertension constitutes a great problem in modern medicine. Due to it being widespread in the society, it seems justified to introduce complex treatment and prevent from this disease. Hypotensive qualities of yoga exercise described in literature constitute an interest as an alternative form of cardiological rehabilitation.

Material and methods. In order to evaluate its influence on the values of blood pressure and pulse, a group of people attending hatha yoga classes was studied. It was assumed that circulatory system parameters would decrease when influenced by training, and the size of those changes would depend on age, health condition and selected environmental factors. Before, during and after the classes arterial blood pressure and pulse were measured. The study was supplemented by the author's questionnaire consisting of

15 questions with given response categories.

Results. Great age difference, majority of female subjects and those with higher education and white collar jobs were observed during the study.

The results proved good perception of subjects' own health condition and their little knowledge concerning realistic parameters of their circulatory system.

Decrease of arterial blood pressure and pulse due to hatha yoga exercise were detected during the study, as well as a greater decreasing tendency in subjects with high arterial blood pressure.

Conclusions formulated as a consequence of the study concern the influence of hatha yoga exercise on circulatory system parameters and its possible use in order to obtain better hypotensive effect.

S t r e s z c z e n i e

Wstęp. Nadciśnienie tętnicze stanowi duży problem dla współczesnej medycyny. Z uwagi na znaczne rozpowszechnienie w społeczeństwie zasadne wydaje się wdrożenie kompleksowego leczenia i przeciwdziałania tej chorobie. Wykazane w piśmiennictwie właściwości hipotensyjne treningu jogi spowodowały zainteresowanie możliwością wykorzystania go jako alternatywnej formy rehabilitacji kardiologicznej.

Materiał i metody. W celu oceny jego wpływu na wartości ciśnienia tętniczego i częstość tętna badaniu poddano grupę osób uczęszczających na zajęcia hatha jogi. Założono, że parametry układu krążenia ulegną obniżeniu pod wpływem treningu, a wielkość tych zmian będzie uzależniona wiekiem, stanem zdrowia i wybranymi czynnikami środowiskowymi. Dokonano pomiaru ciągłego ciśnienia tętniczego i częstości tętna przed rozpoczęciem

zajęć, w trakcie trwania oraz po ich zakończeniu. Badania uzupełniono autorską ankietą, składającą się z 15 pytań z podanymi kategoriami odpowiedzi.

Wyniki. Zaobserwowano duże różnice wieku osób podejmujących trening hatha jogi oraz przewagę płci żeńskiej, wyższego wykształcenia i umysłowego charakteru pracy.

Stwierdzono stosunkowo dobre odczucie stanu zdrowia badanych osób i małą świadomość o rzeczywistych parametrach własnego układu krążenia.

Key words: yoga, circulatory system, hypertension, changes, environmental determinants

Słowa kluczowe: joga, układ krążenia, nadciśnienie, zmiany, uwarunkowania środowiskowe

INTRODUCTION

Yoga is one of the oldest sciences practiced by man, while centuries old tradition and numerous supporters confirm that it is very up to date and universal. Its condition, which is continuous self improvement, takes place in eight stages and leads to achieving absolute cognition – samadhi [1]. However, one of the side effects of yoga is its healing influence on the organism. As a result, practicing it is a sort of antidote for life nuisances in the 21st century. It is very likely that nowadays yoga can offer even more to us – the Europeans [2].

Taking into account high frequency of hypertension occurrence and the complexity of its etiology, it was decided that yoga's influence on circulatory system parameters should be evaluated. The only other trial found in literature was performed by L. Kulmatycki, who studied arterial pressure before and after relaxation training of yoga in subjects with its high values [3]. Present studies on yoga are conducted in very few academic facilities in Poland, and one of the most vibrant is Academy of Physical Education in Katowice, where the Academic Yoga Society was established. The work of members of the society and especially its president, professor J. Szopa, has resulted in publications concerning yoga and its influence on the organism [4, 5, 6, 7, 8, 9, 10]. However, a significant majority of available literature is of popular scientific character [1, 11, 12, 13, 14, 15, 16].

The issue of non-pharmacological methods of treating hypertension is widely described in the subject literature [17, 18, 19]. Trials of evaluating the influence of various forms of cardiological rehabilitation [20, 21, 22, 23], as well as relaxation exercise [24] and massage on the circulatory system parameters [25, 26] were found in literature. The analysis of collected literature allows the conclusion that yoga training is connected with the influence of both physical exercise and

Wykazano obniżenie wartości ciśnienia tętniczego i częstości tętna pod wpływem treningu hatha jogi, oraz większą tendencję spadkową badanych parametrów u osób z wysokimi wartościami ciśnienia tętniczego.

Wnioski. Sformułowano wnioski dotyczące wpływu treningu hatha jogi na parametry układu krążenia oraz możliwości jego stosowania w celu uzyskania efektu hipotensyjnego.

relaxation on the organism. A certain bipolarity of this exercise system explains the interest in its hypotensive properties. Unfortunately, yoga as a tool of preventing and treating hypertension, in significant majority of literature appears as two separate issues, and only few authors notice the possibility of taking advantage of healing properties of yoga in terms of arterial pressure [1, 2, 25, 27]. Having considered the aforementioned ideas, trying to synthesize the knowledge derived from literature and evaluating the influence of yoga training on circulatory system parameters seems justified.

MATERIAL AND METHODS

The study was conducted in Bydgoszcz from June 2010 to end of February 2011, and included the subjects participating in hatha yoga classes conducted by a physical therapist and a yoga teacher. The group consisted of 30 people at the age between 21 and 60, 28 of whom (93.33%) were women. The classes lasted 90 minutes and included taking poses known as asanas, in which a crucial element is calm, steady breathing. Each session ended with a seven – minute relaxation. Utilizing holter blood pressure monitor, arterial pressure and pulse values were taken before, during and after the yoga session. The readings began five minutes after subjects took a comfortable sitting position. The time of reading before and after the class was 30 minutes. Obtained readings were supplemented by a survey, utilizing author's questionnaire including 15 multiple choice questions. First five questions concerned social identification of the subjects, the following ones related to their hatha yoga or other physical activity training, while the last three questions allowed a subjective evaluation of the respondents' health condition in the context of specific diseases.

Collected data was compiled by means of basic statistical methods, such as Student t test. Statistical significance of differences was established on the level

of $p < 0.05$ and $p < 0.01$. The evaluation of the values of the observed changes in arterial blood pressure and pulse was conducted by bringing the difference of means to the value of first reading's standard deviation. The values of the studied parameters of circulatory system read before and after training were correlated with selected results of questionnaire questions [28].

RESULTS

Survey results allowed the authors to establish that each age interval, of 31-40, 41-50, 51-60, consisted of 26.66% of the group, while younger subjects constituted 20%. More than half of the group had higher education (63.33%), while the remaining subjects had secondary education (36.66%). Most participants of hatha yoga classes performed white collar jobs (83.33%), and physical workers or unemployed constituted equal groups (6.66%). Subjects in intellectual – physical profession constituted smallest group (3.33%).

For significant majority of subjects (86.66%) hatha yoga classes had a highly positive influence on their physical comfort. It gave a moderately positive impression to 10% of subjects, while only 3.33% of participants failed to experience any influence on their physical comfort. Subjects evaluated the influence of exercise on their mental comfort in a similar manner. It was described as positive by 76.67% of respondents and as moderately positive by 23.33%.

Analysis of the data related to subjects' health indicated that 80% did not suffer from hypertension and the remaining 20% were part of the population burdened with high blood pressure. Nearly everybody in the group (96.66%) had not been diagnosed with arteriosclerosis, nobody in the group suffered from diabetes.

In order to evaluate the influence of hatha yoga exercise on blood pressure and pulse, readings of circulatory system parameters before and after the exercise were compiled, as presented in table 1.

As it can be concluded from table 1, after finishing the classes the studied group is characterized by lower mean values of all parameters, and differences between those values and the ones from before the classes are statistically significant. It is noticeable that observed changes in studied parameters to the greatest and at the same time similar extent concerned pulse (0.69) and diastolic pressure (0.64), with lower values for systolic pressure (0.43).

Table I. *Comparative characteristics of arterial pressure values and pulse after hatha yoga session*

Tabela I. *Charakterystyka porównawcza wartości ciśnienia tętniczego i częstości tętna po treningu hatha jogi*

Category	Exam	M	σ	D	t	Mollison Index
Pulse (beats/min)	I	77.10	13.48	9.33	4.03**	0.69
	II	67.77	8.50			
Systolic pressure (mmHg)	I	135.33	17.39	7.56	2.85**	0.43
	II	127.77	19.07			
Diastolic pressure (mmHg)	I	94.73	14.08	9.03	4.42**	0.64
	II	85.70	14.95			

** Statistically significant difference $p < 0.01$

For 30 persons the value of t test is: for alfa 0.05=2.03, for alfa 0.01=2.72

Table II presents correlation of readings of arterial blood pressure and pulse with selected results of the survey.

Table II. *Characteristics of correlations of arterial pressure readings and pulse readings with selected results of questionnaire*

Tabela II. *Charakterystyka zależności wyników badań wartości ciśnienia tętniczego i częstości tętna z wybranymi rezultatami badań ankietowych*

Category	Age	Time span of practising yoga	Frequency of yoga exercise	Diagnosed hypertension
Pulse I (beats/min)	0.17	0.12	0.05	-0.08
Pulse II (beats/min)	0.03	0.01	-0.04	-0.32
Systolic pressure I (mmHg)	0.26	-0.12	-0.07	-0.54
Systolic pressure II (mmHg)	0.45	-0.10	0.09	-0.50
Diastolic pressure I (mmHg)	0.27	0.01	-0.08	-0.42
Diastolic pressure II (mmHg)	0.31	-0.08	-0.09	-0.51

Numerical data enclosed in table 2 lead to the conclusion that the majority of characteristics of survey questions correlated poorly with parameter readings. A low correlation was discovered between age and systolic pressure read before the exercise, and between both readings of diastolic pressure. A moderate correlation was observed between the age and diastolic pressure after hatha yoga session. A negative low correlation occurred between pulse read after the exercise and diagnosed hypertension admitted in the survey. A negative correlation of readings of both blood pressures and suffering from hypertension was discovered.

Due to a significant number of subjects whose arterial pressure was high, exceeding normal, when evaluated in first reading, further study material was differentiated according to its values. As a result, a group of 13 subjects with normal values of blood pressure was selected – from this point on referred to as subjects with normal arterial pressure, and a group of 17 subjects with arterial pressure (systolic pressure ≥ 140 , diastolic pressure ≥ 90) – from this point on referred to as subjects with high arterial pressure. Comparative characteristics of the studied parameters are presented in table III.

Table III. *Comparative characteristics of the changes in arterial pressure and pulse of subjects with normal and high values of arterial pressure*

Tab. III. *Charakterystyka porównawcza zmian ciśnienia tętniczego i częstości tętna osób z prawidłowymi oraz wysokimi wartościami ciśnienia tętniczego*

Category	M ₁₃	M ₁₇	σ_{13}	σ_{17}	D ₁₃	D ₁₇	t ₁₃	t ₁₇
Pulse I (beats/min)	73.54	79.82	8.37	16.09	7.39	10.82	3.11**	2.88*
Pulse II (beats/min)	66.15	69.00	8.09	8.85				
Systolic pressure I (mmHg)	121.23	146.12	8.47	14.47	6.38	8.47	1.83	2.42*
Systolic pressure II (mmHg)	114.85	137.65	11.48	17.91				
Diastolic pressure I (mmHg)	83.23	103.53	4.44	12.45	6.61	10.88	2.84*	4.80**
Diastolic pressure II (mmHg)	76.62	92.65	6.83	15.86				

* Statistically significant difference $p < 0.05$

** Statistically significant difference $p < 0.01$

For 13 persons the value of t test is: for alfa 0.05=2.18, for alfa 0.01=3.06

* Statistically significant difference $p < 0.05$

** Statistically significant difference $p < 0.01$

For 17 persons the value of t test is: for alfa 0.05=2.12, for alfa 0.01=2.92

As it may be concluded from the table, studied parameters of subjects with normal arterial pressure decreased after hatha yoga session. Statistically significant differences on the level of 0.01 were discovered only in the evaluation of the changes on pulse. In the group of subjects with high arterial pressure, means of all parameters decreased. All differences of means were statistically significant, and the lowest, as far as significance level 0.05 is concerned, was that of systolic pressure.

DISCUSSION

When this study was initiated, it was assumed that hatha yoga training would result in decrease of the values of arterial pressure and pulse. Readings

obtained after data analysis confirmed this assumption. Decrease of both pressure readings as a result of yoga training was stated also by Kulmatycki, who studied its influence arterial pressure in subjects with hypertension. However, results of own study provided a different picture of downward tendency than the presented in similar studies published in available literature. Particularly essential difference was that of significantly greater decrease in diastolic pressure before and after the session, when compared to decrease of this parameter noted in Kulmatycki's study [3]. A positive influence of yoga exercise on circulatory system presented in both studies may become a foundation for using its elements in struggle against hypertension. It should be remembered that the obstacle against reliable evaluation of hypotensive influence of yoga is the fact that such small group of subjects participated in the study.

A possible explanation of yoga's hypotensive effect is its toning influence on the nervous system, which is frequently and extensively discussed in literature [1, 2, 9, 29]. Yoga, along with Schultz's Autogenic Training and Jacobson's Method are the relaxation methods most frequently described in literature [29, 30, 31, 32], hence it seems relevant to compare results of own study with the influence of relations on the circulatory system parameters. This issue became of interest to the Wrocław's Academy of Physical Education. In their studies they observed that autogenic training developed by Szyszko-Bohusz resulted in decrease of both arterial blood pressure and pulse. The authors pointed out those methods of relaxation ought to be more frequently adapted as a form of prophylactic and treatment of hypertension [24]. Taking into account aforementioned study results, it can be assumed that in case of presently studied subjects, too, approaching a relaxed condition in a significant manner influenced the circulatory system parameters, and the methods utilized to achieve such condition are characterized by a similar effectiveness.

In order to evaluate hypotensive effect of yoga, its effectiveness and results of studies concerning the influence of therapeutic massage on the circulatory system parameters were compared. A downward tendency discovered in the analysis of data proved analogous to the results obtained in the studies on the influence of therapeutic massage on the selected parameters of the circulatory system, in which the greatest decrease of the studied parameters applied to pulse, then diastolic and systolic pressure [25]. When

analyzing obtained data, a significantly higher hypotensive influence of hatha yoga than massage was observed [25, 26].

An important aspect of the conducted study was propagating yoga exercise as a prophylactic and therapeutic method, primarily concerning high blood pressure. In Poland, basic methods of treating this disease is pharmacotherapy and a change of lifestyle as far as diet and undertaking physical activity is concerned [17, 18, 19, 33, 34, 35]. Publications are available in comprehensive medical literature concerning studies on changes occurring in blood pressure when affected by cardiological rehabilitation including work-out and utilizing cycle ergometers. In those studies it was proven that controlled physical effort caused or contributed to decrease of arterial blood pressure [20, 21, 22]. Hypotensive effect, obtained during the study seems to confirm this relation. Yoga exercise used as a form of cardiological rehabilitation might exhibit a similar effectiveness. Acquired results and available publications prove that it is relevant to conduct other, frequently more attractive for patients, forms of physical activity directed at lowering arterial pressure [23]. In consequence, it seems fully justified to use elements of yoga as an alternative method of cardiological rehabilitation combining hypotensive influence of physical activity with relaxation.

In the course of the study, it became apparent that the objective evaluation of the level of blood pressure significantly deviates from the subjects' awareness. The group of subjects with diagnosed hypertension constituted only 20% of subjects in total, however, the results obtained before hatha yoga training proved that in more than 56% of subjects the readings of arterial pressure exceed norms. This issue resulted in dividing subject into two groups. The percentage of subjects in whom readings reached values classified as hypertension exceeds the frequency of this disease occurring in Polish society, in which 50% of men and 40% of women suffer from hypertension [34]. Lack of awareness concerning circulatory system parameters and such wide spreading of its high values in the group of subjects may imply that this condition occurs more frequently than suggested by the statistics. It needs to be pointed that the division was executed solely for the requirements of the study, and actual picture of hypertensive subjects can be evaluated only with comprehensive medical examination. As indicated by the analysis, decrease of readings of both systolic and

diastolic pressure, as well as pulse, is more explicit in the group of subjects with high blood pressure. This result is reflected in other publications, in which decrease of arterial pressure in subjects with its high readings was observed [20].

The thesis concerning the influence of age, time span and frequency of practicing hatha yoga on changes in the readings of arterial pressure and pulse occurring after the session was not fully verified. Most correlations are characterized by nearly insignificant relation. Significant relation occurred solely between the results of the studied parameters and age. Relying on this, one could indirectly conclude that decrease of pressure exhibited after hatha yoga exercises were more often marked in young subjects. It may be assumed that the circulatory system of the young operates more efficiently, and its parameters undergo changes resulting from effort or relaxation in a more explicit manner. Material gathered from the survey allowed characterization of the group of hatha yoga participants. A significant majority of subjects were women, which points to the conclusion that men much more seldom select yoga as recreational physical activity. A similar tendency can be observed in other publications [3,6]. A tendency not related to sex was age of the subjects. Studied group was very varied age – wise, which seems to confirm the thesis that hatha yoga training is suitable for participants at any age [6]. Social characteristics state that majority of members of hatha yoga group in Bydgoszcz had higher education and performed white collar jobs. The characteristics of this group may be related to their higher level of self awareness and desire of growth, as well as greater knowledge about pro health influence of yoga, when compared to those not as well-educated. Respondents, when choosing hatha yoga classes, expected mainly improving their physical, then mental comfort. Subjects' expectations seemed to have been fulfilled, since a great majority of the respondents pointed to a positive influence on both physical and mental comfort. A similarly positive effect of yoga was described in other publications [3,6].

Obtained results, due to their relative value, connected with low headcount of the group, do not allow drawing unequivocal conclusions concerning tackled problems. However, they confirm hypotensive influence of hatha yoga and they justify executing exercise using this method as a non pharmacological method of treating hypertension. A positive influence of yoga training was reinforced by the subjective

evaluation via survey. A successful verification of the majority of posed hypotheses ought to be treated as a confirmation of relevance of further studies in this area. Procured results may be utilized in preliminary evaluation of the problem and they can form a trajectory for further studies with expected equally successful result, which should be widely spread and included in treatment and prophylactic. Those presently presented allowed formulation of the following conclusions.

CONCLUSIONS

1. Confirmed in the study decrease in readings of arterial pressure and pulse attests to a positive effect of hatha yoga training on the circulatory system, and aforementioned changes in the parameters of subjects with high readings of arterial pressure justify executing yoga exercise in order to gain hypotensive effect.

2. A positive influence of hatha yoga training on the organism is confirmed by subjective perception of the subjects in the scope of physical and mental comfort, which can result in improving the quality of life and reducing stress, and furthermore, it can intensify hypotensive effect and constitute a prophylactic for cardio-vascular diseases.

3. Objectively read arterial pressure, contrasting with the knowledge and perception of its value in subjects, justifies the need for its regular reading and improving society's awareness concerning prophylactic of hypertension.

4. The lack of influence of time span of practicing yoga and the frequency of training on the changes in values of arterial pressure and pulse occurring after session, attests to the possibility of selective and irregular utilizing elements of this method during sessions, which aim at gaining hypotensive effects.

5. A domination of female participants, higher education and white collar professions in subjects may prove the upper classes' higher awareness of the health advantages of hatha yoga training and justify the necessity of its propagation among the remaining part of the society.

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Address for correspondence:

mgr Zuzanna Piekorz

Katedra i Zakład Kinezyterapii i Masażu Leczniczego
UMK w Toruniu

Collegium Medicum im. L. Rydygiera w Bydgoszczy
ul. M. Curie Skłodowskiej 9
85-094 Bydgoszcz

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