Original Article

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Physiology Section

Role of One Month Yoga Training on Arterial Stiffness in Young Adults with Familial Hypertension: A Prospective Interventional Study

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ABSTRACT

Introduction: Family history of hypertension is an important non modifiable risk factor that may lead to development of hypertension in otherwise healthy individuals. This is reflected in altered vascular stiffness parameters in these subjects. Yoga has been shown to improve these parameters and may help prevent or at least postpone the future development of hypertension.

Aim: To find out the association between family history of hypertension and vascular stiffness and to determine the effect of yoga as a therapeutic tool in subjects at risk of future hypertension.

Materials and Methods: This prospective interventional study was conducted from September to November 2023 at Centre for Yoga and Exercise Physiology, Shri B.M. Patil Medical College and Research Centre, Karnataka, India. Study included a total of 126 apparently healthy consenting undergraduate individuals aged between 18 and 30 years. Anthropometric, physiological, as well as arterial stiffness parameters like pulse wave velocity and Arterial Stiffness Index (ASI), were recorded using Periscope preintervention at week zero and post-yoga intervention at week four. Statistical Package for the Social Sciences (Version 20.0) was used to analyse the data. For normally distributed data, an independent t-test was used and for non normally distributed data Mann-Whitney U test was used, with p-value <0.05 considered statistically significant.

Results: The study consisted of 46.8% boys and 53.2% girls, with a mean age of 19.94±1.422 years. Significant associations were found between male and females in anthropometric, physiological and arterial stiffness parameters, including Rt. Brachial ASI (p-value=0.002), Rt. Ankle ASI (p-value=0.034), and vascular age (p-value=0.013). At week 0, subjects with family history of hypertension showed appreciable differences in the mean values of vascular parameters, but significant association was only brachial ASI (p-value=0.013). Statistically significant results were observed when the effect of yoga was assessed between week 0 and 4 across most parameters; but group-specific effect of yoga intervention, particularly for subjects with family history of hypertension, was observed only on Rt. Ankle ASI (p-value=0.027).

Conclusion: This study revealed a gender difference in arterial stiffness parameters, as well as the significant effect of four weeks of yoga intervention following the prescribed yoga protocol in young adults. Although not statistically significant, differences in mean values also indicate group-specific differences in arterial stiffness parameters favouring stiffer vessels in subjects with family history and the group-specific effects of yoga might warrant further study.

Keywords: Blood pressure, Family history, Periscope, Vascular stiffness

INTRODUCTION

Hypertension is a major contributor to the global burden of non communicable diseases and is especially hard to manage in low-income countries [1]. It is a major future predictor for cardiovascular diseases, which constitute around 27% of all non communicable diseases [2]. After the new American College of Cardiology and American Heart Association guidelines, the present scenario is even worse where majority of the hypertensive population remain undiagnosed [3]. A family history increases the likelihood of precipitating outcomes by adding hereditary predisposition to the mix [4]. Family history of hypertension is an important non modifiable factor that has been associated with a much higher risk of development of hypertension in the subject as well as increased risk of cardiovascular events [5]. They form an important subset of our population may benefit from early screening and lifestyle modification-based intervention in the prehypertensive phase.

One important aspect of hypertension is vascular ageing. Vascular ageing, caused by oxidative stress, production of free radicals and neuroendocrine and genetic changes, may lead to increased stiffness of vessels reflecting in the presence of increased vascular pulse wave velocity [6,7]. Arterial stiffness is a consequence of vascular ageing. In young adults, vascular ageing can indicate an increased risk of cardiovascular events, as well as an increased risk of development of hypertension. It has also been linked to many other non cardiac complications, including renal impairment and cerebral white matter lesions [8,9]. Measurement of carotid-femoral pulse wave velocity is considered a gold standard test to measure arterial stiffness and this can be performed by using a non invasive machine called Periscope [10]. Some studies have shown that family history of hypertension may result in increased arterial stiffness parameters [11,12].

Yoga has been recommended by the guidelines of the Ministry of Health and Family Welfare, Government of India, as a part of management of primary hypertension [13]. It has been shown by many primary studies as well as systematic reviews and meta-analyses, have demonstrated that yoga improve cardiovascular health of the subjects [14,15]. Given that almost 35% of Indians currently suffer from hypertension, which not only affects them but also an important risk factor for development of future hypertension in their normotensive offspring, it is important to take preventive steps and lifestyle based modifications like Yoga can greatly help this population [16].

This effect of yoga on young adults—those with a family history of hypertension—has not been extensively studied. In the present study, yoga intervention was given to the participants, and postintervention arterial stiffness parameters were assessed. This study also compared the pre- and postintervention parameters of the individuals with a family history of hypertension to those without such a history of hypertension to assess any group-specific effect of the intervention. The present study was focused to find out the association between family history of hypertension and vascular stiffness and also, to determine the effect of yoga as a therapeutic tool in subjects at risk of future hypertension. Present study also looked at gender as well as group i.e., subjects with and without any family history of hypertension comparison of the baseline as well as postintervention parameters.

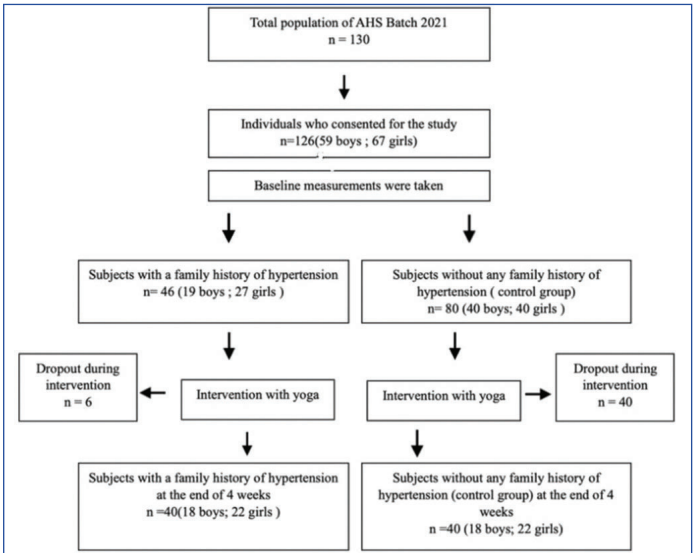
MATERIALS AND METHODS

The present study was a prospective interventional study conducted at the Centre for Yoga and Exercise Physiology, Department of Physiology, Shri B.M. Patil Medical College and Research Centre, BLDE (Deemed to be University), Vijayapura, Karnataka, India. The study was conducted between September 2023 and November 2023. Ethical approval was obtained from the Institutional Ethical Committee (IEC) (Reference No. 1017/2023-24) on 23rd June 2023. Informed consent was obtained from all the participants. This work was carried out in compliance with the Declaration of Helsinki.

Inclusion criteria: All consenting undergraduate individuals (Allied Health Sciences Course) above the age group of 18 and below the age group of 30, studying at BLDE (Deemed to be University), Vijayapura, Karnataka, India were included in the study.

Exclusion criteria: Individuals with any vascular diseases, endocrine diseases, chronic diseases/individuals who are on antihypertensive treatment/who are known to have any past history of cardiovascular events and individuals having history of smoking or alcoholism were excluded from the study.

Sample size: This study included all consenting individuals from the Undergraduate (Allied Health Sciences Course), 2020-21 batch at BLDE (Deemed to be University), Vijayapura, Karnataka, India. The study design, including the number of participants, has been specified in [Table/Fig-1].



[Table/Fig-1]: Study design.

Study Procedure

Initial measurements for all participants, including both anthropometric and arterial stiffness parameters, were recorded in the morning between 8 am and 11 am at the Centre for Yoga and Exercise Physiology, as per the selection criteria and study design, all participants were called to the Centre for Yoga and Exercise Physiology daily in the morning between 8.15 am and 9 am for one month (four weeks), six days a week. As per yoga protocol recommended by Morarji Desai National Institute of Yoga, New Delhi, mentioned in [Table/Fig-2]. Yoga training was given to all the participants under the supervision of an expert [17].

S. No.	Yoga practices	Rounds	Duration
1	Prayer		1 minute
2	*Yogic Sukshma Vyayama* (micro circulation practice)		8 minutes
	a) Neck movements:		
	Forward and backward bending	3 rounds	
	Right and left bending	3 rounds	
	Right and left twisting	3 rounds	
	Neck rotation (Clock and anticlockwise)	3 rounds	
	b) Shoulder movements		
	Shoulder stretch	3 rounds	
	Shoulder rotation (forward and backward)	3 rounds	
	c) Trunk movement		
	Trunk twisting (Kati shakti Vikasak)	3 rounds	
	d) Knee movement	5 rounds	
	e) Ankle movement	5 rounds	
	Ankle stretch	5 rounds	
	Ankle rotation	5 rounds	
3	*Yogic Sthula Vyayama*		3 minutes
	Sarvangapusti	2 rounds	
	Rekhagati	2 rounds	
	Urdhva-gati (upward movement)	2 rounds	
4	*Suryanamaskar*	3 rounds	5 minutes
5	Yoga Asanas		15 minutes
	a. Standing postures		
	Tadasana		
	Urdhva Hastottanasana		
	Katichakrasana		
	Trikonasana		
	b. Sitting postures		
	Bhadrasana		
	Vakrasana/ArdhaMatsyendrasana		
	Ushtrasana		
	Sasakasana		
	UtanaMandukasana		
	c. Prone postures		
	Bhujangasana		
	Makarasana		
	Dhanurasana		
	d. Supine postures		
	Pavanamuktasana		
	Matsyasana		
	Sarvangasana/Viparitakarani		
	Shavasana		
6	*Kapalabhati*- optional	(10-20 strokes)	1 minute
7	Pranayama (without Kumbhaka)		6 minutes
	Anuloma-Viloma/Nadishodhana (Alternate Nostril Breathing)	3 rounds	
	Ujjayi Pranayama	3 rounds	
	Bhramari Pranayama	3 rounds	
8	Dhyana		5 minutes
9	Shanti Patha		1 minute
	Total duration		45 minutes

[Table/Fig-2]: Yoga Protocol [17].

The following anthropometric and physiological parameters of all participants were recorded:

1. **Anthropometric parameters:** Height (cm), weight (kg), Body Mass Index (BMI, kg/m^2), Body Surface Area (BSA) and Waist-to-Hip Ratio (WHR).
2. **Physiological parameters:** Heart rate/Pulse Rate (PR, beats/min), Systolic Blood Pressure (SBP, mmHg), Diastolic Blood Pressure (DBP, mmHg), Pulse Pressure (PP, mmHg) and Mean Arterial Pressure (MAP, mmHg).
3. **Arterial stiffness parameters:** Using non invasive oscillometric method-based instrument, Periscope (Genesis Medical Systems, India), following arterial stiffness parameters were recorded: right brachial-ankle Pulse Wave Velocity (PWVb-a right, cm/s), left brachial-ankle Pulse Wave Velocity (PWVb-a left, cm/s), carotid-femoral Pulse Wave Velocity (PWVc-f, cm/s), right brachial Arterial Stiffness Index (Rt. Brachial ASI, mmHg), left brachial Arterial Stiffness Index (Lt. Brachial ASI, mmHg), right ankle Arterial Stiffness Index (Rt. Ankle ASI, mmHg), left ankle Arterial Stiffness Index (Lt. Ankle ASI, mmHg), and vascular age (years).

STATISTICAL ANALYSIS

The data obtained were entered in a Microsoft Excel sheet, and statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 20.0. Results are presented as Mean±SD, counts, percentages and diagrams. For normally distributed continuous variables, values between two groups were compared using an Independent t-test. For non normally distributed variables, Mann-Whitney U test was used. A p-value of <0.05 was considered statistically significant. All statistical tests were performed as two-tailed.

RESULTS

A total of 126 students (59 boys and 67 girls) volunteered for the study out of 130 participants. These volunteers were then divided into two groups based on their family history of hypertension. One group consisted of individuals with a family history (n=46; 19 boys and 27 girls), while the other group comprised those without a family history (n=80; 40 boys and 40 girls). All participants underwent baseline investigations. Following this, they participated in a four-week yoga intervention. However, it is important to note that some participants dropped out during this intervention period (details in [Table/Fig-1]).

The study included more females (53.2%) than males (46.8%). Baseline characteristics, along with gender differences at week 0, are shown in [Table/Fig-3], highlighting significant differences (p-value <0.05) between genders. Females had lower BSA compared to males (1.45±0.14 vs 1.70±0.18; p-value=0.0001), lower WHR compared to males (0.82±0.04 vs 0.86±0.03; p-value=0.0001), lower SBP compared to males (113.11±11.74; 125.03±10.43; p-value=0.0001), lower PP compared to males (46.64±6.75, 57.1±8.41; p-value=0.0001), lower MAP (82.12±9.35 vs 87.03±7.85; p-value=0.002), lower right brachial arterial stiffness index (Rt. Brachial ASI) compared to males (22.87±6.09; 26.09±5.25; p-value=0.002), lower right femoral arterial stiffness index (Rt. Femoral ASI) compared to males (27.35±7.56 vs; 29.89±5.59; p-value=0.034), and lower vascular age compared to males (17.71±3.03; 19.15±3.34; p-value=0.013). Conversely, their PR was significantly higher compared to males (82.57±12.90; 75.38±11.37; p-value=0.001).

Interestingly, [Table/Fig-4] revealed no significant baseline differences in arterial stiffness parameters between participants with and without a family history of hypertension, except in Lt. Brachial ASI (p-value=0.013) at week 0. [Table/Fig-5] depicts the difference between participants with family history of hypertension and without family history of hypertension at week four post-yoga intervention. There were no significant differences found between these two groups, except in two parametres: Lt. brachial ASI (p-value=0.048) and Rt. ankle ASI (p-value=0.014).

[Table/Fig-6] demonstrates a positive effect of the yoga intervention on the participants. Participants who underwent the four-week yoga program experienced a significant decrease in Rt. brachial PWV (p-value=0.014), Lt. brachial PWV (p-value=0.005), carotid-femoral PWV (PWV c-f) (p-value=0.001), Rt. brachial ASI (p-value=0.049), Rt. ankle ASI (p-value=0.0001), Lt. ankle ASI (p-value=0.047), and vascular age (p-value=0.001). [Table/Fig-7] depicting the group-specific effect of yoga demonstrates significant association only in Δ Rt. ankle ASI (p-value=0.027).

DISCUSSION

The present study revealed a significant association between gender and both anthropometric as well as arterial stiffness parameters. This showed a significant decrease in arterial stiffness parameters in women as compared to men, consistent with previous work in this field.

Variables	Total	Male	Female	Independent t-test	p-value
	Mean±SD	Mean±SD	Mean±SD		
BMI (kg/m^2)	21.66±4.59	22.21±4.01	21.18±5.03	1.27	0.205
BSA (m^2)	1.57±0.20	1.70±0.18	1.45±0.14	8.04	0.0001*
Waist/Hip ratio	0.84±0.04	0.86±0.03	0.82±0.04	4.93	0.0001*
Pulse rate (bpm)	79.17±12.67	75.38±11.37	82.57±12.90	-3.31	0.001*
SBP (mmHg)	118.74±12.60	125.03±10.43	113.11±11.74	6.01	0.0001*
DBP (mmHg)	67.16±8.30	67.93±7.79	66.47±8.74	0.98	0.325
PP (mmHg)	51.58±9.19	57.1±8.41	46.64±6.75	7.60	0.0001*
MAP (mmHg)	84.44±8.99	87.03±7.85	82.12±9.35	3.19	0.002*
Rt. brachial PWV (cm/s)	1001.03±179.32	1030.56±168.91	974.63±185.43	1.76	0.080
Lt. brachial PWV (cm/s)	939.99±146.83	954.99±188.42	926.58±95.19	1.04	0.299
Carotid femoral PWV (cm/s)	575.929±103.9551	594.11±111.69	559.67±94.42	1.85	0.057
Rt. brachial ASI (mmHg)	24.394±5.9134	26.09±5.25	22.87±6.09	3.16	0.002*
LT. brachial ASI (mmHg)	20.096±6.7542	21.04±8.30	19.24±4.89	1.45	0.150
Rt. ankle ASI (mmHg)	28.554±6.8024	29.89±5.59	27.35±7.56	2.14	0.034*
Lt. ankle ASI (mmHg)	31.326±5.8832	31.85±6.47	30.85±5.30	0.94	0.347
Vascular age (years)	18.39±3.255	19.15±3.34	17.71±3.03	2.50	0.013*

[Table/Fig-3]: Baseline and gender specific difference in parameters (Week 0).
Data are represented as mean (SD): BMI: Body mass index; BSA: Body surface area; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; PP: Pulse pressure; MAP: Mean arterial pressure; PWV: Pulse wave velocity; ASI: Arterial stiffness index. *Indicates significant p-value <0.05

Variables	With family history of hypertension	Without family history of hypertension	Independent t-test	p-value
	Mean±SD	Mean±SD		
BMI (kg/m^2)	22.66±5.41	21.08±3.95	1.73	0.088
BSA (m^2)	1.59±0.25	1.55±0.16	0.82	0.41
Waist/Hip ratio	0.84±0.04	0.84±0.04	-0.21	0.83
Pulse rate (bpm)	76.94±11.75	80.48±13.08	-1.55	0.12
SBP (mmHg)	119.72±14.14	118.16±11.67	0.66	0.509
DBP (mmHg)	67.85±8.37	66.76±8.29	0.70	0.484
PP (mmHg)	51.87±8.91	51.41±9.41	0.27	0.784
MAP (mmHg)	85.3±9.79	83.94±8.51	0.78	0.432
Rt. brachial PWV (cm/s)	1021.42±184.42	989.16±176.38	0.95	0.34
Lt. brachial PWV (cm/s)	941.45±177.21	939.14±127.10	0.07	0.93
Carotid femoral PWV (cm/s)	584.77±88.39	570.77±112.24	0.77	0.442
Rt. brachial ASI (mmHg)	23.59±5.52	24.86±6.11	-1.19	0.237
LT. brachial ASI (mmHg)	18.02±7.36	21.30±6.09	-2.55	0.013*
Rt. ankle ASI (mmHg)	28.16±5.95	28.78±7.27	-0.51	0.61
Lt. ankle ASI (mmHg)	31.23±5.68	31.38±6.03	-0.13	0.89
Vascular age (years)	19.91±0.96	19.96±1.63	0.95	0.341

[Table/Fig-4]: Group specific difference in parameters at week 0.
Data are represented as mean (SD): BMI: Body mass index; BSA: Body surface area; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; PP: Pulse pressure; MAP: Mean arterial pressure; PWV: Pulse wave velocity; ASI: Arterial stiffness index. *Indicates significant p-value <0.05

Variables	With family history of hypertension	Without family history of hypertension	Independent t-test	p-value
	Mean±SD	Mean±SD		
BMI (kg/m^2)	22.05±4.89	20.46±3.93	1.59	0.114
BSA (m^2)	1.59±0.26	1.52±0.16	1.32	0.188
Waist/Hip ratio	0.84±0.03	0.84±0.05	0.64	0.522
Pulse rate (bpm)	76.64±6.81	78.06±12.97	-0.61	0.541
SBP (mmHg)	116.95±15.6	114.7±15.37	0.64	0.517
DBP (mmHg)	65.5±6.9	64.15±9.3	0.73	0.463
PP (mmHg)	51.45±11.63	50.55±9.02	0.38	0.7
MAP (mmHg)	82.03±8.92	81±10.88	0.46	0.648
Rt. brachial PWV (cm/s)	945.31±190.54	950.53±202.28	-0.11	0.905
Lt. brachial PWV (cm/s)	890.97±187.83	871.65±187.1	0.46	0.646
Carotid femoral PWV (cm/s)	531.76±152.01	508.26±167.82	0.65	0.513
Rt. brachial ASI (mmHg)	22.22±7.45	24.81±5.49	-1.77	0.08
LT. brachial ASI (mmHg)	18.69±7.89	22.65±9.66	2	0.048*
Rt. ankle ASI (mmHg)	29.55±10.01	27.14±6.48	-2.49	0.014*
Lt. ankle ASI (mmHg)	29.55±7.05	30.27±7.63	-0.43	0.662
Vascular age (years)	17.88±3.47	16.55±4.15	1.52	0.134

[Table/Fig-5]: Group specific difference in parameters at week 4.
Data are represented as mean (SD): BMI: Body mass index; BSA: Body surface area; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; PP: Pulse pressure; MAP: Mean arterial pressure; PWV: Pulse wave velocity; ASI: Arterial stiffness index. *Indicates significant p-value <0.05

The present study aligns with previous research by demonstrating a significant association between gender and arterial stiffness parameters [18,19]. This effect is mostly attributed to the protective effects of female sex hormone oestrogen, whose receptors are found in vascular musculature, which include short-term vascular effects and by potentiating endothelium-dependent vasodilation [20]. Studies have also found that mutations in genes associated with these receptors leads to increased arterial stiffness parameters [21].

Variables	Week 0	Week 4	Independent t-test	p-value
	Mean±SD	Mean±SD		
BMI (kg/m^2)	21.3±4.51	21.28±4.54	0.29	0.773
BSA (m^2)	1.56±0.22	1.55±0.22	0.09	0.96
Waist/Hip ratio	0.84±0.04	0.83±0.04	-0.04	0.963
Pulse rate (bpm)	77.62±12.66	77.35±10.32	0.134	0.883
SBP (mmHg)	117.45±13.41	115.82±15.43	1.11	0.478
DBP (mmHg)	66.83±7.9	64.82±8.17	1.35	0.115
PP (mmHg)	50.61±8.88	51±10.35	1.47	0.799
MAP (mmHg)	83.53±9.14	81.5±9.92	-0.28	0.185
Rt. brachial PWV (cm/s)	1018.88±148.89	947.92±195.27	2.5	0.014*
Lt. brachial PWV (cm/s)	946.34±166.73	881.31±186.53	2.89	0.005*
Carotid femoral PWV (cm/s)	585.75±100.22	520.01±159.88	3.54	0.001*
Rt. brachial ASI (mmHg)	25.31±5.46	23.51±6.63	1.95	0.049*
LT. brachial ASI (mmHg)	20.59±7.49	20.67±8.98	-0.05	0.995
Rt. ankle ASI (mmHg)	29.18±6.01	24.79±8.71	3.96	0.0001*
Lt. ankle ASI (mmHg)	31.86±5.74	29.91±7.30	1.87	0.047*
Vascular age (years)	18.79±3.06	17.18±3.88	3.33	0.001*

[Table/Fig-6]: Effect of four week yoga intervention.
BMI: Body mass index; BSA: Body surface area; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; PP: Pulse pressure; MAP: Mean arterial pressure; PWV: Pulse wave velocity; ASI: Arterial stiffness index. *Indicates significant p-value <0.05

Variables	With family history of hypertension	Without family history of hypertension	Mann-Whitney U	p-value
	Mean±SD	Mean±SD		
Δ Rt. brachial PWV (cm/s)	55.42±112.60	51.28±192.72	720	0.441
Δ Lt. brachial PWV (cm/s)	35.06±120.15	57.85±149.28	690	0.29
Δ Carotid femoral PWV (cm/s)	56.76±108.34	64.17±145.92	740	0.564
Δ Rt. brachial ASI (mmHg)	1.31±7.51	-0.88±8.49	708	0.376
Δ LT. brachial ASI (mmHg)	-0.67±11.25	-1.94±9.69	691	0.294
Δ Rt. ankle ASI (mmHg)	5.46±10.97	1.28±8.71	570	0.027*
Δ Lt. ankle ASI (mmHg)	1.75±8.51	1.92±10.31	734	0.525

[Table/Fig-7]: Group specific effect of 4 week yoga intervention.
Δ: Difference between week 0 values and week 4 values, PWV: Pulse wave velocity; ASI: Arterial stiffness index. *Indicates significant p-value <0.05

No significant association was found between arterial stiffness parameters between subjects with and without family history of hypertension at week 0, except for left brachial ASI (p-value=0.013). Although previous studies have shown that family history of hypertension may significantly impact the vascular stiffness of normotensive offspring, the results of the present study do not show such results [22,23]. This might be due to the relatively younger population included in the study, where physical changes might not have completely set in.

A significant effect on arterial stiffness was observed among participants who received four-week yoga intervention, as shown in the [Table/Fig-6]. This study indicates that there was improvement in the values of arterial stiffness parameters even with four-week yoga intervention. Several other studies have also indicated the

effectiveness of yoga but generally with a longer duration. Yoga is known to impart beneficial effects in regard of vascular stiffness parameters by its effect on endothelial function in the short-term and the vascular remodelling in the long term [24-27]. In this study, the effect was primarily due to its effect on endothelial function, although no molecular markers were investigated to confirm this with certainty.

No group-specific effect of yoga intervention were found between subjects with and without a family history, except for Δ right ankle ASI. Although this result might point out the effectiveness of yoga intervention in this specific at-risk group, further research and validation are needed. It may prove to be an important tool in help the group of people with a non modifiable risk factors/with family history of similar risk, at least to delay the onset of hypertension.

This study provides preliminary evidence for the effectiveness of yoga in improving arterial stiffness in young adults. To gain a more comprehensive understanding of the underlying mechanisms, future research should explore the role of yoga in modulating specific molecular parameters like endothelial Nitric Oxide Synthase (eNOS), Matrix Metalloproteinases (MMPs), Erythropoietin (Epo), and Vascular Endothelial Growth Factor (VEGF).

Limitation(s)

The small study population, along with the large number of dropouts as well as subtle vascular changes seen in young adults in this age group being harder to appreciate, are the limitations of this study.

CONCLUSION(S)

The present study highlights the potential of yoga as a non invasive intervention for improving arterial health in young adults. The present study presents evidence proving the effectiveness of four-week yoga intervention in reversing vascular ageing processes. Further research is needed to explore the long-term effects of yoga and its effectiveness in mitigating the impact of family history on arterial stiffness.

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