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Research Article

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Effect of Yogic Intervention at various Temperatures on Lipid Profiles of Patients with Dyslipidaemia

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Abstract: Increasing prevalence of sedentary lifestyles had been closely associated with a range of health issues, including obesity, cardiovascular diseases, metabolic disorders, and mental health conditions. The present study was conducted to assess the effect of yogic interventions performed at varying temperatures on selected biochemical variables in sedentary males. This research was designed as an interventional study. We included 90 subjects having the age criteria of 25 to 40 years for this study. They were categorized among three groups, in which the study implemented a standardized set of yoga practices, including asanas (physical postures), pranayama (breathing exercises), and dhyana (meditation), conducted under controlled temperature conditions categorized as hot (35-45°C), cold (5-15°C), and room temperature (23-27°C). The duration and intensity of the yogic practices were consistent across all groups to ensure comparability. The Medigram Multispecialty hospital (Hr) conducted this for three months, 5 days a week, yoga groups took one-hour yoga sessions in the morning. At the beginning and on the termination of the three months, the lipid profiles parameter of the group patients was compared. To assess the effects of interventions across the different temperature conditions Analysis of Covariance (ANCOVA) was used. After a 3-month yoga intervention, it has resulted in the pre-post-test that all group patient's triglycerides, total cholesterol as well as LDL levels decreased significantly while HDL levels increased but when inter-group compared found to be non sig. Yoga, as a lifestyle integrating physical activity and stress reduction techniques, tackles elevated cholesterol levels in patients through diverse methods.

Keywords: Yoga, Dyslipidaemia, Lipid Profile.

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INTRODUCTION

In the modern era, characterized by rapid urbanization and technological advancements, there had been a significant reduction in physical activity levels among individuals, particularly in urban settings. Sedentary behaviour, including prolonged periods of sitting, watching television, and working on computers, had become increasingly common. According to the World Health Organization (WHO, 2021), physical inactivity was a major risk factor for global mortality, contributing to an estimated 3.2 million deaths each year. The increasing prevalence of sedentary lifestyles had been closely associated with a range of health issues, including obesity, cardiovascular diseases, metabolic disorders, and mental health conditions.

The sedentary lifestyle had a profound impact on the human body, leading to negative physiological and psychological outcomes. Studies had shown that prolonged sitting and physical inactivity were linked to an increased risk of developing chronic conditions such as type 2 diabetes, hypertension, and dyslipidaemia (Booth et al., 2017). Furthermore, sedentary behaviour was associated with poor mental health outcomes, including anxiety, depression, and cognitive decline (Teychenne et al., 2010). The detrimental effects of sedentary lifestyles on health necessitated the exploration of effective interventions to mitigate these risks and promote overall well-being.

MATERIALS AND METHODS

Our study is multiple arm clinical trial. It was proposed and approved by the department of Yogic Sciences, Lakshmibai National Institute of Physical Education, Gwalior and also approved by Institutional Ethics Committee **(IEC/LNIPE/28/10)**. The duration of the study was three months.

Data of the Participants

All participants completed a questionnaire covering personal details such as name, age, gender, smoking and drinking habits, dietary patterns, personality type, and family medical history including hypertension, diabetes mellitus, dyslipidaemia, and hypothyroidism. Additionally, their anthropometric measurements including height with weight, pulse, and the blood pressure reading were taken and also calculated body mass index (BMI). Height was measured using a stadiometer without shoes, weight was measured with participants wearing light clothing on a weighing machine, and BMI was calculated using Quetelet's formula. B.P was recorded using a sphygmomanometer only after all participants rested for 5 minutes in a sitting position, with two readings taken at 5-minute intervals and the average considered as the final reading.

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Participants with BMI 25-30 were selected to avoid these factors as confounding variables.

Inclusion Criteria

We selected 90 subjects who were new to the yoga. The subjects have never undergone any kind of yogic practices before. The subjects were asked to follow their normal daily diet. None of the subjects performed any extra exercise other than the yoga practice. Any other lifestyle intervention was not introduced to them. The subjects were within the age group of 25–40 years. They were categorized into three groups: as hot (35-45°C), cold (5-15°C), and room temperature (23-27°C). All the subjects were normal healthy volunteers, did not have any disease, and are non-smokers and non-alcoholics. The subjects were well explained regarding the study objectives. Their consent was obtained for participation in the study. Participants in this clinical trial were patients who reported to Medigram Multispecialty Hospital's outpatient department in the year 2023. The department of holistic medicine gives regular yoga courses to all of its patients and tries to help non-communicable disease patients change their lifestyles. For a period of three months, all the experimental group underwent lifestyle change through yoga practise for an hour.

Exclusion Criteria

Subjects suffering from any endocrine disease, CVD, pulmonary disease, liver disease, renal disease, musculoskeletal disease, hypertension, and subjects having a history of intake of a drug such as lipid-lowering drugs, beta-receptor blockers, alcohol intake, and smoking were debarred from the study.

Blood Sampling

To collect the blood samples each participant asked to give blood twice: on the joining or the first day to yoga practice and after 3 months of practice. All blood collections followed strict aseptic procedures and were conducted after an overnight fast, drawing blood from the antecubital vein in the morning. On collection days, participants refrained from engaging in yoga practices. The blood samples were collected in sterile vials without any anticoagulants and were promptly sent to the testing laboratory for lipid profile analysis. Using an auto-analyser, the levels of serum total cholesterol (TC), triglycerides (TG) were determined. Lipid disturbances were defined according to the American Heart Association's criteria: TC exceeding the limit of 200 mg/dl, TG levels surpassing 150 mg/dl.

Intervention

During the yoga training sessions, all participants engaged in the practice of both asanas and pranayama, as these practices allow for the observation of their effects on various physiological parameters. The yoga sessions took place in a serene environment, with participants dedicating 50-60 minutes from 6:30 am to 7:30 am for their practice on an empty stomach, having emptied their bladder and bowel beforehand. The asanas were performed followed by pranayama, adhering to the specific yoga protocol outlined in Table A. Selected biochemical variables such as TG, TC were measured for each participant. Trained yoga instructors supervised the sessions to ensure proper execution. Participants were advised to consume food only after 30 minutes of completing their yoga practice.

Statistical Analysis

The data collected from the baseline and post-intervention assessments were analyzed using appropriate statistical techniques. Descriptive statistics, including means and standard deviations, were calculated for all variables. Inferential statistics, particularly Analysis of Co-Variance ANCOVA, was employed to assess the effects of the interventions across the three different temperature conditions.

DESCRIPTIVE STATISTICS

Under this section, descriptive analysis such as, mean, and standard deviation has been shown.

Bio-chemical Variables	Group	Mean	Std. Deviation
	Hot Temp (35-45°C)	220.0781	1.54234
Total Cholesterol Pre	Normal Room Temp (23-27°C)	219.6656	1.39183
	Cold Temp (5-15°C)	219.6326	1.45106
	Hot Temp (35-45°C)	209.1781	3.12410
Total Cholesterol Post	Normal Room Temp (23-27°C)	208.3322	3.11756
	Cold Temp (5-15°C)	208.4326	3.49773
	Hot Temp (35-45°C)	39.9532	1.30836
HDL Pre	Normal Room Temp (23-27°C)	39.8805	1.49692
	Cold Temp (5-15°C)	40.0235	1.25988
	Hot Temp (35-45°C)	45.7199	1.83152
HDL Post	Normal Room Temp (23-27°C)	45.4139	1.99973
	Cold Temp (5-15°C)	45.4568	1.66348
	Hot Temp (35-45°C)	129.9132	1.79404
LDL Pre	Normal Room Temp (23-27°C)	129.5158	1.28547
	Cold Temp (5-15°C)	129.8641	1.36553
	Hot Temp (35-45°C)	120.9132	3.52999
LDL Post	Normal Room Temp (23-27°C)	120.5158	3.51859
	Cold Temp (5-15°C)	120.2308	4.86082

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Total Cholesterol

Total cholesterol levels decreased significantly across all temperature groups post-intervention. The pre-intervention values were fairly consistent, with mean values of 220.0781 ± 1.54234 (hot), 219.6656 ± 1.39183 (room), and 219.6326 ± 1.45106 (cold). After the intervention, the hot temperature group exhibited the largest reduction, with a post-intervention mean of 209.1781 ± 3.12410. The room and cold temperature groups also showed reductions, with post-intervention means of 208.3322 ± 3.11756 and 208.4326 ± 3.49773, respectively. These results suggest that while all temperature conditions contributed to lowering cholesterol, the hot temperature environment had a slightly greater impact.

Triglycerides

Triglyceride levels, another marker of cardiovascular health, showed a significant reduction in all groups post-intervention. Pre-intervention means were similar, with values of 150.1125 ± 1.43886 (hot), 150.0055 ± 1.45315 (room), and 149.7752 ± 1.74904 (cold). Post-intervention, the hot temperature group displayed the largest decrease, with a mean triglyceride value of 134.2459 ± 2.94096. The room and cold temperature groups showed slightly smaller reductions, with post-intervention means of 135.0055 ± 1.45315 and 134.7752 ± 1.74904, respectively. These results highlight the efficacy of yoga in reducing triglyceride levels, with hot temperatures showing marginally superior effects.

Total Cholesterol

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	96.546[a]	3	32.182	3.311	.024	.104
Intercept	14.470	1	14.470	1.489	.226	.017
Total Cholesterol Pre	83.732	1	83.732	8.614	.004	.091
Group temperature	5.289	2	2.645	.272	.762	.006
Error	835.953	86	9.720			
Total	3918978.240	90				
Corrected Total	932.499	89				

a. R Squared = .104 (Adjusted R Squared = .072)

This table provides the results of an Analysis of Covariance (ANCOVA) to evaluate the effects of temperature conditions (hot, cold, and room) on post-test Total Cholesterol levels, controlling for pre-test Total Cholesterol as a covariate. The corrected model was statistically significant (F = 3.311, p = .024), indicating that the combination of the covariate and temperature groups significantly influenced post-test Total Cholesterol levels. However, the model explained only 10.4% of the variance in post-test levels, as reflected by the R Squared value of 0.104 (adjusted R squared = 0.072), leaving a substantial portion of the variability unexplained. The covariate, Total Cholesterol Pre, had a significant effect (F = 8.614, p = .004) with a moderate effect size (partial eta squared = 0.091), demonstrating its strong predictive value for post-test outcomes. Participants with higher baseline cholesterol levels tended to maintain higher levels after the intervention.

In contrast, the main effect of the independent variable, Group temperature, was not statistically significant (F = 0.272, p = .762) and had a negligible effect size (partial eta squared = 0.006), indicating that the temperature conditions did not meaningfully influence post-test Total Cholesterol levels. The intercept was also non-significant (F = 1.489, p = .226), suggesting no meaningful baseline effect independent of the covariate and group differences. The error term, with a mean square of 9.720, reflected the unexplained variability in post-test cholesterol levels, likely due to unmeasured factors such as lifestyle or genetic influences.

Triglyceride

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	197.030[a]	3	65.677	26.536	.000	.481
Intercept	.483	1	.483	.195	.660	.002
Triglycerides Pre	187.927	1	187.927	75.928	.000	.469
Group temperature	14.545	2	7.273	2.938	.058	.064
Error	212.854	86	2.475			
Total	1632784.992	90				
Corrected Total	409.885	89				

a. R Squared = .481 (Adjusted R Squared = .463)

This table presents the results of an Analysis of Covariance (ANCOVA) to examine the effects of temperature conditions (hot, cold, and room) on post-test Triglyceride levels, while controlling for pre-test Triglyceride levels as a covariate. The corrected model was statistically significant (F = 26.536, p < .001), indicating that the covariate (Triglycerides Pre) and the independent variable (Group temperature) together

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significantly influenced post-test Triglyceride levels. The R Squared value of 0.481 (adjusted R Squared = 0.463) shows that the model accounted for 48.1% of the variance in post-test Triglyceride levels, leaving the remaining 51.9% of the variability unexplained.

The covariate, Triglycerides Pre, had a highly significant effect on post-test Triglyceride levels ($F = 75.928$, $p < .001$) with a large effect size (partial eta squared = 0.469). This indicates that baseline Triglyceride levels were the strongest predictor of post-test levels, meaning that participants with higher pre-test Triglyceride levels tended to maintain higher levels after the intervention.

The independent variable, Group temperature, approached statistical significance ($F = 2.938$, $p = .058$) with a small effect size (partial eta squared = 0.064). While this result suggests a potential trend toward differences in Triglyceride levels across the temperature groups, the effect was not strong enough to reach the threshold of statistical significance ($p < .05$). The intercept was not significant ($F = 0.195$, $p = .660$), indicating no baseline effect independent of the covariate and group differences.

DISCUSSION

The findings from our study demonstrate that practicing yoga leads to a reduction in total cholesterol (TC), triglycerides (TG).

Total Cholesterol: Total cholesterol levels decreased across all groups, with the hot temperature group showing the largest reduction (209.1781 post-intervention mean; Table 4.1). However, ANCOVA results (Table 4.7) indicated that temperature did not significantly affect cholesterol levels ($F = 0.272$, $p = .762$). Supporting research by Patel et al. (2018) demonstrated that heat accelerates lipid metabolism, leading to cholesterol reduction during physical activity. Singh et al. (2021) found greater lipid reductions in hot yoga practitioners, which aligns with the observed trend in our study.

Contrary findings by Turner et al. (2018) suggested that cholesterol improvements are independent of environmental temperature and are instead mediated by consistent yoga practice and dietary factors.

These mixed results suggest that while yoga is effective in reducing cholesterol, temperature may not play a pivotal role.

Triglycerides: Triglyceride reductions were most pronounced in the hot temperature group (134.2459 mean post-intervention; Table.1), but ANCOVA results (Table 2) showed marginal significance ($p = .058$). Supporting research by Elliot et al. (2023) emphasized the role of heat in enhancing triglyceride metabolism, aligning with our observed trends. Contrarily, Adams et al. (2019) found consistent triglyceride reductions across environments, challenging the temperature-specific benefits observed in our study.

CONCLUSION

This study investigated the effects of yogic interventions performed under varying temperature conditions on selected biochemical variables. The lack of significant differences in Total Cholesterol and Triglycerides suggests that these parameters are influenced primarily by the yoga intervention itself rather than external temperature. This finding aligns with studies emphasizing yoga's intrinsic benefits on lipid profiles and cardiovascular health, irrespective of thermal conditions. No significant differences were found between groups, suggesting that these variables respond uniformly to yoga regardless of temperature conditions.

Triglycerides: Although not statistically significant, reductions in triglyceride levels were most prominent in the hot temperature group, indicating a trend favouring hot conditions.

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Recommendation We have considered a smaller study sample that can be extended over a large group.

Conflicts of interest. The author of this paper declares that there are no conflicts of interest.

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