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Effect of modified proprioceptive neuromuscular facilitation type Suryanamaskar on body composition of college level students

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Abstract
The purpose of the study was to study the effect of modified PNF type Suryanamaskar on body composition of college level students. Here study was conducted on 80 college students which were randomly divided into three experimental groups and one control group i.e. 20 in each group. The age was from 17 to 28 yrs. The practice of the traditional Suryanamskar, PNF Exercises and newly developed modified PNF type Suryanamaskar was given to the three experimental groups respectively for 12 weeks. To find the effect of the treatment pre and post data of height, body weight, BMI and fat percentage for body composition was taken and descriptive statistics analysis and ANCOVA with multiple treatment was used at 0.05 level of significance.
The significant difference was found in experimental groups ($p<0.05$). The application LSD for pairwise comparison of variables of body weight, fat% and BMI showed significant trends for treatments. Hence it was concluded that that Suryanamaskar, PNF Exercises as well as PNF type Suryanamaskar were good for improving body composition of college level students.

Keywords: Suryanamaskar, PNF exercise, modified PNF type Suryanamaskar

Introduction
The idea of modified Proprioceptive Neuromuscular Facilitation type Suryanamaskar started from the majority of yoga learners, who were usually performing for fitness and good health. On the other hand, the various types of stretching exercises are done by athletes for their good performance in games and sports. By using PNF stretching an individual can increase one's flexibility, strength, agility and mobility of various muscles. Hence the idea of PNF type Suryanamaskar was prepared by researcher with the help of supervisor and other experts for training purpose and was further used to see the effect of modified PNF type Suryanamaskar on body composition of college level students.
Here the principles and techniques of Proprioceptive Neuromuscular Facilitation (PNF), stretching were used along with traditional Suryanamaskar. The agonist and antagonist muscles were used in all the postures of Suryanamaskar and hence modified PNF type Suryanamaskar was formed to see its effect on selected variables of body composition of college level students.

Procedure and Methodology
There was total of eighty college level students of Physical Education and Sports, Delhi University randomly divided in to four groups, one control group and three experimental groups namely-

a. Control group- 20 subjects
b. Traditional Suryanamaskar- 20 subjects (experimental group)
c. PNF exercise group-20 subjects (experimental group)
d. PNF type Suryanamaskar consisting 20 subjects (experimental group)

The age of the subjects will be college going students of physical education and sports ranging from 17 – 28 years of age who are also participating in competitive sports at different level.

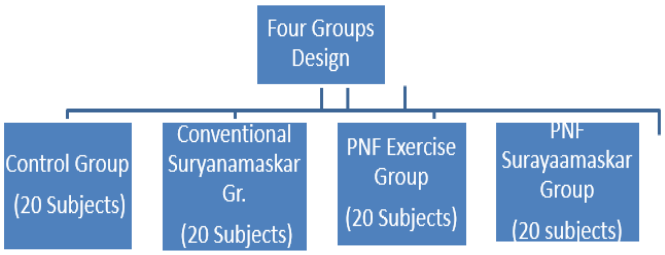

Fig 1

Suryanamaskar
Suryanamaskar is a sequence of 12 bodily postures. These interchanging backward and forward bending postures flex and stretch the spinal column and limbs of upper and lower body over their maximum range giving a deep to the whole body.

PNF exercises
PNF exercises are mass movement patterns using various techniques in a posture to attain maximum stretch actively or passively. Here 13 postures are selected for PNF stretching exercise of head, neck, trunk, lower and upper extremities. The techniques of contract-relax, hold relax of mass movement of agonist and antagonist muscles are used to exercise as per command.

Modified PNF type Suryanamaskar

The modified PNF type suryanamskar uses both the traditional suryanamskar and PNF techniques to form a type of mass movement exercise to have benefit of both type of stretching along with other added effects of extraordinary routine. It consists of 25 postures which includes apart from 12 traditional suryanamskar postures, some added mass movement as per technique of PNF stretching.

Analysis of the study

An analytical study was designed to assess the collected data with related interpretation and graphical representation. The present study has been represented by descriptive statistics with comparison between four groups. A control group and three experimental groups, namely Suryanamaskar (SN), Proprioceptive Neuromuscular Facilitation exercise (PNF) and Proprioceptive Neuromuscular Facilitation type Suryanamaskar (PNFSN) groups.

Descriptive statistical analysis

Descriptive statistical analyses like mean, SD, standard error, range were calculated on the selected physical, physiological and psychological variables of present study. The adjusted means of variables were also displayed in graphical form.

(ANCOVA) Analysis of covariance was used on obtained data sets of the groups to calculated the difference of significance at .05 level. The advantage of using the ANCOVA is that the alterations in the post-testing means are remunerated for the early differences in the scores. In other words, it may be considered that the effects of covariate is abolished in comparing the effectiveness of the treatment groups in post testing (Verma J. P. 2011) [24]. The post hoc test was also applied to find whether or not there is significance difference among the groups for various dependent or posttests of the selected variables. For dissimilarities and post hoc tests, again look to the columns labelled Sig. to discover if comparison of pairwise were significant, if the significance value is less than .05. Here Least Significant Difference (LSD) was applied as the no. of subjects in each group were equal and hence pairwise comparison on variables is done, wherever it is significant after applying ANCOVA.

Findings of the study

In this study body weight, fat% & BMI was taken by machine of body composition analyzer (BCA). The collected data had been analyzed with the help of IBM SPSS Statistics 22 software by computing the descriptive statistics, ANCOVA and post hoc test was applied wherever the significant difference was obtained in ANCOVA. The collected data have been computed in the following tables from 1 to 3.

Body weight

Table 1: Descriptive Statistics of the Variable Body Weight

S. No.	Groups	Mean	SD	Adjusted Mean	Std. Error
1.	Control	58.18	6.97	63.19	.33
2.	SN	63.51	6.13	62.17	.32
3.	PNF	62.28	12.46	63.02	.32
4.	PNFSN	65.77	8.13	61.95	.33
	Total/Grand Mean	62.58	9.15		

Total N =80

The table no. 1 revealed that the descriptive calculation as mean and SD for the four groups of such as Control, SN, PNF and PNFSN were 58.18±6.97, 63.51±6.13, 62.28±12.46 and 65.77±8.13 respectively and the adjusted means were found to be 63.19, 62.17, 63.02 & 61.95 of the respective groups. The standard errors for four groups were ranging from .33 to .32 and grand mean was 62.58. The graphical representation of the data is presented in figure 2.

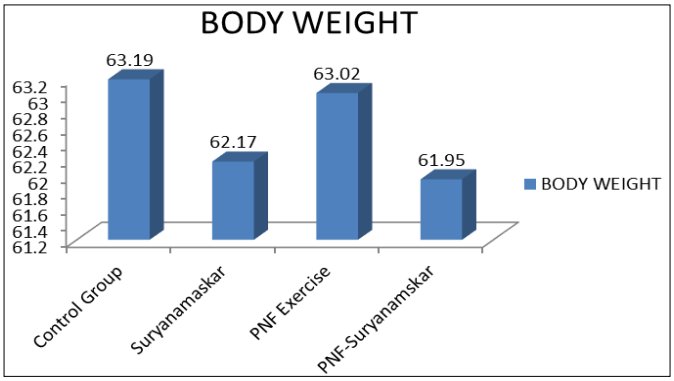

Fig 2: Graphical presentation of adjusted Mean of Body Weight

Table 2: ANCOVA Applied on the Variable of Body Weight

Source	Sum of Squares	df	Mean Squares	'F'	Sig.
Interaction in Groups	20.53	3	6.84	3.34	0.024
Error	153.85	75	2.05		
Corrected Total	6609.06	79			

The table no 2 revealed that there was significant difference observed among the four groups as calculated F (3, 75) = 3.34, P < .05. The calculated value was 0.024, which is significant at 0.05 level.

As there was a significant difference found in body weight so the post hoc test, least significant difference (LSD) was applied on the data and the findings were presented in table 3.

Table 3: Least significant difference (LSD) on Dependent Variable – Body Weight for Pairwise Comparisons

S. No.	Groups (I)	Groups(J)	Mean Diff.(I-J)	Std. Error	Sig.
1.	CG	SN	1.03	.46	.030*
		PNF	.18	.46	.698
		PNFSN	1.24	.47	.011*
2.	SN	PNF	-.85	.46	.066
		PNFSN	.26	.46	.637
3.	PNF	PNFSN	1.06	.46	.024*

*The significant difference found at .05 level.

Table 4 showed result of the LSD-corrected post hoc pairwise means comparisons. The significant difference was found between the control group (CG) and Suryanamaskar group(SN) of mean values 63.19 & 62.17 respectively and with mean difference 1.03, (p = .030) at p<.05. The significant difference was also found between CG and PNFSN, mean values of 63.19 & 61.95 and with mean difference 1.24, (.011) at p<.05. Whereas, the CG and PNF groups were not found significant and SN group was also not significant with PNF & PNFSN groups, p>.05. But it was interesting to find PNF and PNFSN significant difference with mean difference of 1.06, (p = .024) at p <.05 level.

Body composition

Table 4: Descriptive Statistics of Fat Percentage

S. No.	Groups	Mean	SD	Adjusted Mean	Std. Error
1.	Control	14.47	3.02	14.62	.17
2.	SN	15.24	4.27	14.26	.17
3.	PNF	14.93	3.99	14.28	.17
4.	PNFSN	12.04	2.88	13.49	.17
	Total / Grand	14.16	3.74		

Total N =80

The table 4 revealed /as shown that the descriptive calculation as mean and SD for the four groups of Control, SN, PNF, & PNFSN were 14.47± 3.02, 15.24 ± 4.27, 14.93 ± 3.99 and 12.04 ± 2.88 respectively and the adjusted means were found to be 14.62, 14.26, 14.28, & 13.49 of the respective groups. The standard error for four groups was .17 and grand mean was 14.16. The graphical representation of the data is presented in figure 3.

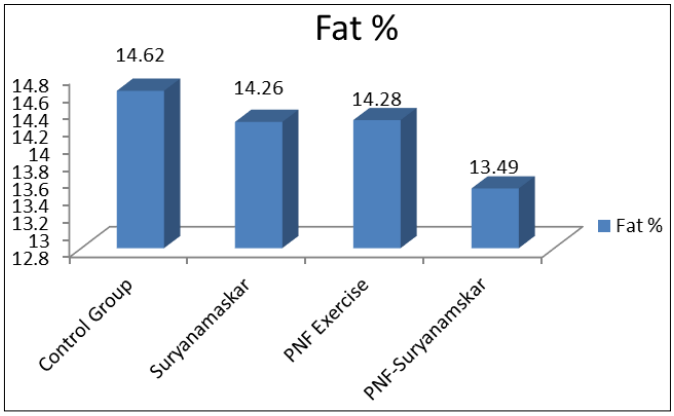

Fig 3. Graphical presentation of Adjusted Mean of Fat percentage

Table 5: ANCOVA Applied on the Variable of Fat Percentage

Source	Sum of Squares	df	Mean Squares	'F'	Sig.
Groups	13.30	3	4.43	7.97	.000
Error	41.72	75	.56		
Corrected Total	1107.33	79			

The table 5 revealed that there was found significant difference among the four groups as calculated F (3, 75) = 7.97, (.000) at P < .01.

Since there was a significant difference found in fat percentage so the post hoc test, least significant difference (LSD) was applied on the data and the findings were presented in table 6.

Table 6: Least Significant Difference (LSD) on Dependent Variable –Fat Percentage for Pairwise Comparisons

S. No.	Groups (I)	Groups(J)	Mean Diff.(I-J)	Std. Error	Sig.
1.	CG	SN	.36	.24	.134
		PNF	.35	.24	.148
		PNFSN	1.13	.24	.000*
2.	SN	PNF	-.01	.24	.952
		PNFSN	.77	.24	.002*
3.	PNF	PNFSN	.79	.24	.002*

*The significant difference found at .05 level.

Table 6 shows the pairwise mean comparisons. The significant difference was found between the control group and PNFSN group with mean value of 14.62 & 13.49 and mean difference of 1.13, (.00) at p<.01. The significant difference was also found between SN and PNFSN groups, (.77, .002) and PNF and PNFSN groups, .79, .002 p<.01. Whereas CG with SN and PNF groups were not found significant differences and also SN was not significant with PNF group, at p>.05.

Body mass index

Table 7: Descriptive Statistics of Body Mass Index

S. No.	Groups	Mean	SD	Adjusted Mean	Std. Error
1.	Control	19.61	1.51	19.47	.22
2.	SN	20.59	2.22	19.55	.22
3.	PNF	20.07	3.13	23.39	.28
4.	PNFSN	21.65	1.83	19.51	.25
	Total / Grand	20.48	2.34		

Total N =80

The table 7 revealed that the descriptive calculation as mean and SD for four group e.g. Control, SN, PNF & PNFSN groups were 19.61± 1.51, 20.59±2.22, 20.07±3.13, & 21.65±1.83 respectively and adjusted mean were 19.47, 19.55, 23.39 & 19.51 of the respective groups. The standard errors for four groups were between .22 and .28 and grand mean was 20.48±2.34. The covariates appearing in the model are evaluated at the following values of pre adjusted BMI Mean of 19.377. The graphical representation of the data is presented in figure 4.

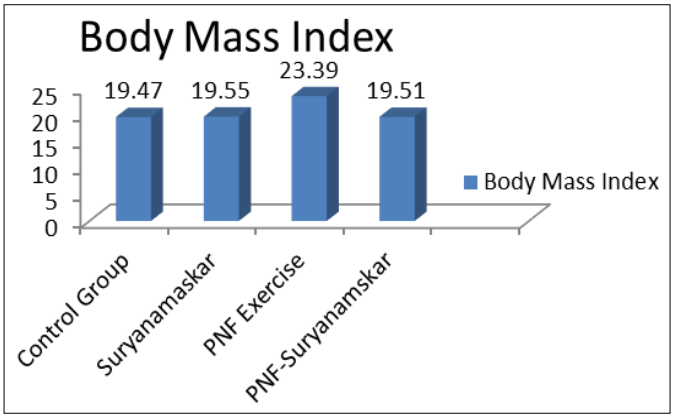

Fig 4: Graphical presentation of Adjusted Mean of Body Mass Index

Table 8: ANCOVA Applied on the Variable BMI

Source	Sum of Squares	df	Mean Squares	'F'	Sig.
Groups	124.53	3	41.51	44.42	.000
Error	70.09	75	.93		
Corrected Total	434.51	79			

The table 8 revealed that there was found significant difference among the four groups as calculated F = (3, 75) = 44.42, at P < .01.

Since after applying ANCOVA there was a significant difference found in BMI so for the post hoc test least significant difference (LSD) was applied on the data and the findings were presented in table 9.

Table 9: Least Significant Difference (LSD) on Dependent Variable –BMI for Pairwise Comparisons

S. No.	Groups (I)	Groups(J)	Mean Diff.(I-J)	Std. Error	Sig.
1.	CG	SN	-.08	.31	.803
		PNF	-3.92	.36	.000*
		PNFSN	-.04	.32	.903
2.	SN	PNF	-3.84	.39	.000*
		PNFSN	.09	.31	.90
3.	PNF	PNFSN	3.88	..47	.000*

*The significant difference found at .05 level.

Table 9 shows the pairwise mean comparisons. The significant difference was found between the control group and PNF group with mean value of 19.47 & 23.39 and mean difference -3.92, (.00) at p<.01. The significant difference was also found between SN and PNF groups, -3.92 (.00) and also PNF and PNFSN groups, 3.88 (.00) at p<.01. Whereas CG with SN and PNFSN groups and SN with PNFSN were groups not found significant, p>.05.

Discussion on findings of the study

Taking in consideration the Analysis of the study and the supportive review literature the investigator interpreted the following finding for the study.

The present study was designed in such a way that the college level students are tested for their selected variables of body weight, fat% and BMI, for which three experimental groups had undergone complex training which included Suryanamaskar, PNF Exercises and modified PNF type Suryanamaskar. The total duration of each workout session including warming up, training and cooling down was of twenty five minutes to forty minutes. On the other hand control group was not involved in these types of training although they were taking all other college activities. Data of the physical, physiological and psychological variables were recorded before and after completion of experiment.

1. Body Weight

The result of the study reveals that after the completion of twelve weeks of training, body weight was found to be significant at 5% level. Table 9 shows that there is a significant difference between Suryanamaskar and Control groups. There is also significant difference between PNFSN and Control Groups. After post hoc test application it was interpreted that Suryanamaskar increase or decrease individual weight as to have ideal weight of individual.

The present study corroborated with findings of Bera *et al.*, conducted on 40 student, after yogic practices result showed increase in ideal body weight, body density & strength and decrease in abdominal circumference & body fat percent.

2. Fat Percentage

The result in figure 4, shows that the adjusted posttest mean of the fat percentage was improved in all three training groups. Since F ratio is significant, post hoc comparison was made for adjusted means of the four treatment groups which is shown in table 9 It may be seen that there was significant difference in control group and PNFSN group. It was concluded that PNFSN group is better than all other groups for improving fat percentage.

3. BMI

Table 9 shows the F – value for comparing the adjusted means of the four treatment groups (Suryanamaskar, PNF, SNPNF and Control) during post testing. Since p-value for F ratio is 0.00 which is less than 0.01, therefore the training groups are significant at 1% level. The post hoc test shows that PNF exercises were better than other groups in improving BMI.

Hence it was concluded that that Suryanamaskar, PNF Exercises as well as PNF type Suryanamaskar were good for improving body composition of college level students.

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