International Journal of Yoga and Allied Sciences
Vol 11, No: 2, July-Dec 2022 pp: 108-122

Kinanthropometric Study of Yoga on School Children

Dr. Srinidhii Alias Amrutha P[1] & Dr. Dincsh Kumar V[2]

1. MBBS, Pondicheny institute of Medical Sciences, Puducherry, India
2. MBBS(MD), Assistant Professor, Department of Anatomy, JJPMER (Jawaharlal Institute of Postgraduate Medical Education and Research), Pondicherry-605006, Puclucherry. India

Received: 01.08.2021 Revised: 01.09.2022

Abstract:

Background and Objectives:

Regular physical activity has multiple benefits. However, modern children often lead less active lives, resulting in obesity. In order to improve their physical fitness yoga is used since it improves flexibility, muscle strength, posture and increases joint space in a natural and indigenous way. Many literatures have found yoga to be effective qualitatively but this study recorded the qualitative and quantitative aspects of yoga using Kinanthropometry.

Methodology:

Study Design: Non-Randomized clinical trial
Study Period: Two months
Sample size□60□: 30 children – Non- yoga group
30 children – Yoga group

Selection criteria:

- Age group: 10-11
- Children free from illness and not under yogic practice

The selected Kinanthropometric parameters were measured on both groups before study initiation. Study group children performed lower limb specific yoga asanas under the guidance of yoga practitioner daily. Measurements were taken at the end of every week during the project period on both groups. These results were statistically analysed.

Results:

Yogic intervention qualitatively and quantitatively showed significant decrease in BMI and skin fold thickness and increase in flexibility. Flexibility parameters were not significant, skin fold and BMI increased in non-yoga group. Findings of many studies are in accordance with this study findings are mentioned in discussion.

Conclusion:

From this study, there is positive impact on children after yogic intervention qualitatively and quantitatively in just 2 months and if continued for longer time one could achieve physical fitness with yogic exercises.

Keywords: Yoga, Flexibility, Skin-fold, Kinanthropometry, Children

Introduction:

Yoga has considerable qualitative effects in improving flexibility, muscle strength, posture and increases joint space in a natural and innate way. Yoga has now become an increasing part of American life and has been included in alternative list of therapies (1). Yoga tones muscles,

tendons, and ligaments, by developing the motion with full range, thus contributing to balance and main strength that can greatly benefit to students with athletic pursuits. Yoga also has positive effects on school children's fitness (2). Limited sources are available to quantify the effects of yoga and thus suggest methods for its application. In order to quantify the changes that occur during yoga intervention, Kinanthropometry, an interface between anatomy and movement, is used as a framework. Kinanthropometry was first used in 1972 (3). Kinanthropometry and its applications (4) are most frequently used to study the anatomical changes to measure the effect of trained, proper, regular movements.

A study (5) on Cuban Olympic volleyball champions, measured their body physique using Kinanthropometry. It was used to compare body's morphology, adiposity (endomorphy) and musculoskeletal development (mesomorphy), linearity (ectomorphy).Using this, they figured out the actual body proportions required to become a physically fit athlete. A comparative study (6) between water polo players of Spain and Portugal assessed the physical and somatotype features of centre and outside players using their Kinanthropometry profile. Another study (7) showed a significant difference in various features like BMI, weight, total leg length, thigh length, hip and calf circumference, percentage of back strength, body fat i.e. anthropometric measures between Indian inter-university male cricketers and control group. Using Kinanthropometry, it was found that long distant runners had significantly greater values of standing height, upper leg and lower leg length whereas mid distance runners had pointedly larger weight and skinfold parameters. But no difference was noted in body girth and skeletal diameters (8). So, it can be concluded that Kinanthropometry has been useful in recent times in assessing the physical fitness of athletes.

Goniometer is a tool used for reliable clinical measurement for the motion range which is a essential evaluation technique with pervasive application in physical treatment (9). In this project, movement is carried out through yoga practice (10) and anatomical changes are measured using selected Kinanthropometry parameters. (11)

Among various forms of physical exercises, yoga can be used to prevent childhood obesity at the school level, since it not only acts as a preventive medicine but also has other therapeutic uses. But there are only limited sources, to show the morphological changes after yoga intervention quantitatively. This study aims to quantify the impacts of yoga by Kinanthropometry in the lower limbs of school children. This was achieved by measuring the parameters in lower limbs pre and post yoga exercises.

Materials And Methods

Study Design: Non randomized clinical trial

Study Period: Two months [June and July -2016]

Setting: A Higher Secondary school in Pondicherry

Selection of Participants: After obtaining the informed consent and assent from parents and students respectively, 60 children (age: 10 to 11 years) were recruited and allocated into 30 children – Yoga (study) group; 30 children – Non-yoga (control) group. Any child with disease and physical deformity of lower limbs and other illness were excluded from the study. Also, children already under yoga practice were omitted from the study. Study was conducted on human participants for health and biomedical research in accordance with the ICMR's Ethical guidelines.

Intervention: Specification, application and relevance of Kinanthropometry are mentioned in Table 1. Selected Kinanthropometric measurements based on (11) given in Table 3 were measured on both the groups before the initiation of the study. Yoga asanas specific to lower limb like Dandasana, Supta Padangusthasana, Trikonasana and Adho Mukha Svanasana

based on (10) were performed daily by yoga group children under the guidance of yoga practitioner for 2 months. Benefits of those asanas are listed in Table 2.

Methods of Measurement: Selected Kinanthropometry measurements listed in Table III were again measured at the end of every week during the project period on both the groups. Final measurements were measured on both the groups . Difference between the initial and final Kinanthropometry measurements in yoga group children gives the overall effect of yoga. By comparing a series of Kinanthropometry measurements, gradual impact can be noted. All the measurements are compared between yoga and control group children to eliminate confounding factors. Along with these measurements their BMI was also noted to assess their physical fitness.

Data Collection and Processing: The study involved 30 students as yoga and 30 students as control groups. After 60 days of yoga, values were recorded.

Statistical Method Used: To analyse all these measurements, two types of statistical analysis which are descriptive statistics and hypothesis tests are used. In descriptive statistics, mean, median and minimum/maximum/kurtosis is done. In hypothesis test, student T-test is done. Results along with their statistical analyses are reported based on the measurements during the conduction of the study. Minitab Express was used as statistical tool for analysis.

Ethical Guidelines: The study was conducted in a higher secondary school after getting ethical approval from IEC (Ref No. IEC: RC/16/07).

Results

The graphs given below show the gradual changes noted every week for each parameter in both the groups. Statistics were done and results are expressed as follows,

Flexibility:

Flexibility was measured at various joints like hip joint, knee joint and ankle joint. Changes in series of measurements noted are as follows

Hip joint flexion:

Yoga group:

There is greater significant difference with t value of 19.35.

Non- yoga group:

There is no significant difference with t value of 0.17 in spite of regular sports activities conducted in school.

On an average, in yoga students hip joint flexion has increased from 90 degrees to 114.5 degrees(difference noted here is 24.5 degrees) whereas in non-yoga students it has remained in 94 degrees itself without any difference (Figure 1). The effect of yoga can be very well observed in yoga students as 24.5 degrees over non-yoga students.

Hip joint extension:

Yoga group:

There is greater significant difference with t value of 14.4.

Non- yoga group:

There is no significant difference with t value of 0.13 in spite of regular sports activities conducted in school.

On an average in yoga students hip joint extension has increased from 11.6 degrees to 23 degrees(difference noted here is 11.4 degrees) whereas in non-yoga students it has remained in 14.8 degrees itself without any difference (Figure 2). The effect of yoga can be very well observed in yoga students as 11.4 degrees over non-yoga students.

Hip joint abduction:

Yoga group:

There is greater significant difference with t value of 19.

Non- yoga group:

There is no significant difference with t value of 0.7 in spite of regular sports activities conducted in school.

On an average in yoga students hip joint abduction has increased from 22 degrees to 37 degrees(difference noted here is 15 degrees) whereas in non-yoga students it has decreased from 32.5 degrees to 31.5 degrees (difference noted here is 1 degree so not considered as significant) (Figure 3). The effect of yoga can be very well observed in yoga students as 15 degrees over non-yoga students.

Knee joint flexion:

Yoga group:

There is greater significant difference with t value of 16 than non-yoga students.

Non- yoga group:

There is significant difference with t value of 4 which is less than yoga students. The change noted here may be due to the regular sports activities conducted in school.

On an average in yoga students knee joint flexion has increased from 120 degrees to 141 degrees (difference noted here is 21 degrees) whereas in non-yoga students it has increased from 115 degrees to 122 degrees (difference noted here is only 7 degrees) (Figure 4). The effect of yoga can be observed in yoga students as 14 degrees over non-yoga students.

Dorsiflexion or Ankle Joint Flexion:

Yoga group:

There is greater significant difference with t value of 6.3.

Non- yoga group:

There is no significant difference with t value of 2 in spite of regular sports activities conducted in school.

On an average in yoga students dorsiflexion has increased from 11.5 degrees to 15 degrees(difference noted here is 3.5 degrees) whereas in non-yoga students it has increased from 11.3 degrees to 12.3 degrees (difference noted here is 1 degree so not considered as significant) (Figure 5). The effect of yoga can be very well observed in yoga students as 2.5 degrees over non-yoga students.

Plantar flexion or Ankle Joint Extension:

Yoga group:

There is greater significant difference with t value of 8.4.

Non- yoga group:

There is no significant difference with t value of 1 in spite of regular sports activities conducted in school.

On an average in yoga students plantar flexion has increased from 24 degrees to 33 degrees(difference noted here is 9 degrees) whereas in non-yoga students it has increased from 21 degrees to 22.4 degrees (difference noted here is 1.4 degrees so not considered as significant) (Figure 6). The effect of yoga can be very well observed in yoga students as 7.6 degrees over non-yoga students.

Skin fold:

Series of measurements of skin fold were taken at front thigh and mid-calf. Skin fold indirectly indicates the amount of subcutaneous fat present in that region .Changes noted are as follows

Front thigh:

Yoga group:

There is greater significant difference which means that there is decrease in deposition of subcutaneous fat in yoga students with t value of 10.8.

Non- yoga group:

There is significant difference with t value of 6.08 but the significance is in the opposite direction. So in non-yoga students there is increase in subcutaneous fat deposition in spite of regular sports activities conducted in school.

On an average in yoga students front thigh skin fold has decreased from 22.6mm to 11.2mm (difference noted here is 11.4mm) whereas in non-yoga students it has increased from 12mm to 19.5mm (difference noted here is +7.5mm) (Figure 7). The effect of yoga can be observed in yoga students as 19mm over non-yoga students.

Mid-Calf:

Yoga group:

There is greater significant difference which means that there is decrease in deposition of subcutaneous fat in yoga students with t value of 15.5.

Non- yoga group:

There is significant difference with t value of 5.3 but the significance is in the opposite direction. So in non-yoga students there is increase in subcutaneous fat deposition in spite of regular sports activities conducted in school.

On an average in yoga students mid-calf skin fold has decreased from 14.5mm to 7.7mm (difference noted here is 6.8mm) whereas in non-yoga students it has increased from 10mm to 14.3mm (difference noted here is +4.3mm) (Figure 8). The effect of yoga can be observed in

yoga students as 11.1mm over non-yoga students.

Body Mass Index (BMI):

Series of measurements of BMI was taken in both the groups .Changes are noted as follows

Yoga group:

There is greater significant difference with t value of 2.7.

Non- yoga group:

There is no significant difference with t value of 1.8 in spite of regular sports activities conducted in school.

On an average in yoga students BMI has decreased from 19.2 to 18.7(difference noted here is 0.5) whereas in non-yoga students it has increased from 19.6 to 20(difference noted here is 0.4) (Figure 9). The effect of yoga can be very well observed in yoga students as 0.9 over non-yoga students.

Discussion

In a similar study (5), participants of 544 in number with the mean age 69.9 with the variation of ±6.3 were included and their physical fitness was measured. This study documented a moderate effect of yoga on balance, gait, body strength, body flexibility and weight loss. 42 different studies on the yoga and its effects on sympathetic/parasympathetic activation and its cardio-vagal action. These studies provide evidence that yoga promotes a shift in balance from primarily sympathetic to parasympathetic. However, there promising findings have to verified with additional research trials with suitable control interventions.

A prospective quasi experimental study (12) was conducted in 2009 in North Mexico where 4 middle aged and 9 old females practicing yoga were involved in an 11 week study consisting of 5sessions/week. In this study there was a slight decrease in body fat and skin fold parameters in both middle and old age groups when initial and final measurements were compared in contrast to body weight and BMI which remained same throughout. According to the author there was no significant modification in anthropometric parameters. The contrasting features observed in this study while compared to our study were due to adult age group and smaller sample size rather than paediatric age group and large sample size.

In our study, important difference was monitored in yoga group in flexibility as improvement in hip joint flexion / extension, hip joint abduction, ankle joint flexion / extension whereas these values remained the same throughout in control group. The most significant parameter was knee joint flexion as greater difference was noted in yoga group (21 degrees) compared to non-yoga group (1 degree). This shows that yoga improves the flexibility and range of motion by increasing the joint space which is in accordance with study (13). A study (14) divided the subjects into yoga, static stretching and control group to assess the range of motion which found that both yoga and static stretching improved the motion range significantly. Better range of motion by the Yoga group than static stretching exhibited with a mean variance of 1.09 degrees (p value<.001, 95% confidence interval). *Malgorzata et al 2015* (15) showed that yoga exercises improved the flexibility of hamstring muscles when measured using various parameters like forward, backward, right and left bend, left and right torsion and Toe-touch test regardless of their age. Significant improvement in flexibility was also noted in the study (16) where the degrees of flexion increased from 15.5±1.4 to 19.55±1.84 in yoga group.

Regarding skin fold also, a significant difference was detected in yoga group in comparison to control group in front thigh and mid-calf skin fold. The decrease in skin fold parameters in yoga group reflects on decrease in subcutaneous fat which is in accordance with the below mentioned studies. A randomized controlled trial conducted (17) had showed a significant decrease in group practised yoga when compared to control group in cumulative skinfold thickness after 14 weeks of yoga training i.e. percentage fat based on skin fold thickness decreased (Pre mean ± Std

Dev=93.93 ± 22.56 and Final Mean ± Std Dev=76.45±11.74 in yoga group). Another study (18) showed that 6 week training of yoga along with dietary modifications had significant decrease in skinfold thickness [from 54.04 ± 10.98 to 51.36 ± 10.99] in yoga group and blood cholesterol levels in obese subjects.

The significant difference noted in yoga group is 0.5 decrease in BMI whereas in control group BMI increased by 0.4. This is because of the fact that yoga normalizes the weight and increases the height in order to achieve a healthy BMI. This is in accordance with studies conducted by British wheel of yoga (19), Medindia (20) and International journal of physical education, health and sports (13) and below mentioned studies. Randomized controlled trial (17) showed significant decrease in BMI in yoga group than control group as it normalizes the weight i.e. decreases the weight in obese individuals (Pre mean ± Std Dev=28.7 ± 2.35 and Final Mean ± Std Dev=27.97 ± 2.21 in yoga group). A study (18) (Pre Mean ± Std Dev=32.39 ± 1.33; Post Mean ± Std Dev=30.72 ± 2.02 in yoga group) and another study (21) (Pre Mean ± Std Dev=31.16±1.76; Post Mean ± Std Dev=29.34 ± 1.95 in yoga group) showed 6 week yoga practice along with dietary modifications showed significant decrease in BMI in obese individuals. A prospective cohort study conducted in *2013* (22) showed that assessment of BMI after 6 month of yoga training showed significant decrease in subjects with coronary artery disease(BMI before yoga=28.6±3;after yoga 26.8±4). A significant decrease in BMI was noted (15) (Pre Mean±Std Dev=26.7±3.5; Post Mean±Std Dev=26.1±3.2 in yoga group). Similar findings were reported (23) in a randomized controlled trial after 1 month of yoga practice in yoga group whereas no variation was observed in control group (BMI before yoga=26.4±2.5;after yoga 25.22±2.4) and also by a study(16) (BMI before yoga=25.53±0.89;after yoga 24.58±0.64).

Conclusion

From our study, we conclude that there is positive impact on children after yoga intervention qualitatively and quantitatively. In our study, we could observe a substantial decrease in BMI, skin fold thickness and an rise in flexibility and height. Weight normalization could be observed in yoga group after regular practise of yoga for 2 months over control group and therefore contributes to physical fitness. The limitations of the study are short duration and presence of confounding factors which cannot be excluded. In future, we wish to do similar studies on this ground to measure the effect of yoga on different diseases and its therapeutic uses could be found out quantitatively and also might improve the conditions of differently abled people. Extension of this study can be carried to study the impact of yoga on a particular muscle and range of motion.

Clinical Relevance

- Effect of yoga could be studied in preventing obesity, cardiovascular diseases and various other diseases by maintaining one's physical fitness.
- This study could also be applied in the rehabilitation of cerebral palsy patients to improve their quality of life.
- This study can be extended on to find out the effect of different asanas for various diseases and effect of combination of multiple asanas.

TABLES

Table 1: Kinanthropometry Aspects			
Aspect	**SPECIFICATION**	**APPLICATION**	**RELEVANCE**
Anatomy	By the study of Size and Morphological changes	In order to understand the Growth and the Exercise	Which is Implied for the Health and the Education

Table 3: Selected Kinanthropometric Measurements			
Sl.No.	**Measurement**	**Measurement Site(s)**	**Instruments**
1	Skin fold	Front thigh, Medial calf	Skin fold caliper
2	Weight	-	Weighing Scale
3	Height	-	Stadiometer
4	Flexibility	Hip joint flexion Hip joint extension Hip joint abduction Knee joint flexion Dorsiflexion Plantar flexion	Goniometer

Table 2: Benefits of Selected Asanas		
Sl. No.	**Name of the Asana**	**Benefits**
1	**Dandasana**	This pose strengthens the back and legs and especially in Hamstrings stretch. It assists sitting posture. It teaches how to extend and ground legs. When legs are grounded the spine extends strongly upward. This pose should bring a feeling of stability.
2	**Supta padangusthasana**	Stretches the hamstrings, calves and gluteals. Encourages both grounding and lengthening of body. The body is totally supported in this posture; this minimizes injury risk*s*.
3	**Trikonasana**	This pose tones the legs, feet, and ankles. The triangular alignment gives one the feeling of balance, alignment, openness and expansion.
4	**Adho Mukha Svanasana**	This pose provides benefits for the entire body. It lengthens the spine and hamstrings, stretches calves, stretches and tones the arms. It also relieves fatigue

FIGURES

Figure 1: Time Series Plot of flexibility in degrees of Hip Joint Flexion

It shows gradual changes noted in Hip Joint Flexion in both the groups over a period of two months.

FIG 1

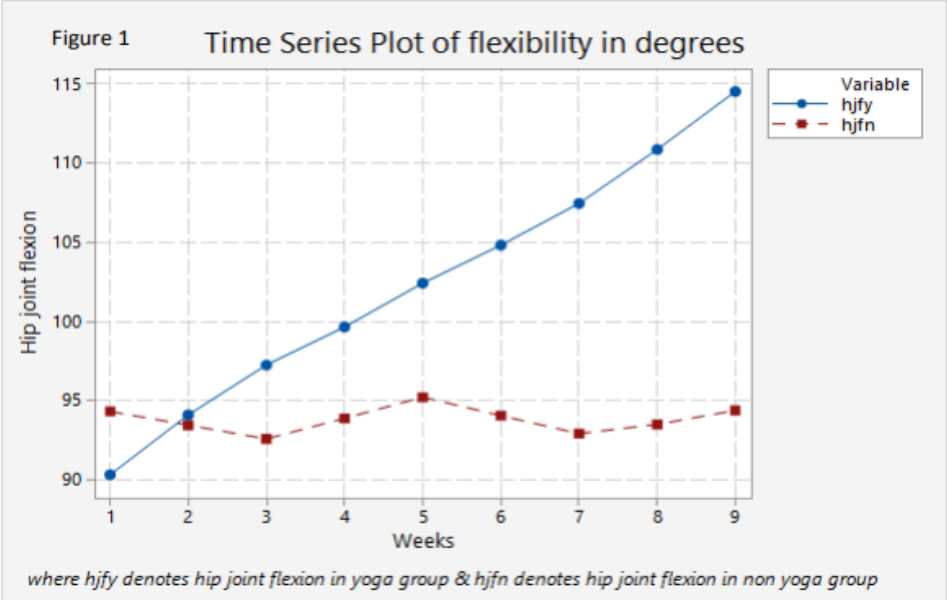


Figure 2: Time Series Plot of flexibility in degrees of Hip Joint Extension

It shows gradual changes noted in Hip Joint Extension in both the groups over a period of two months.

FIG 2

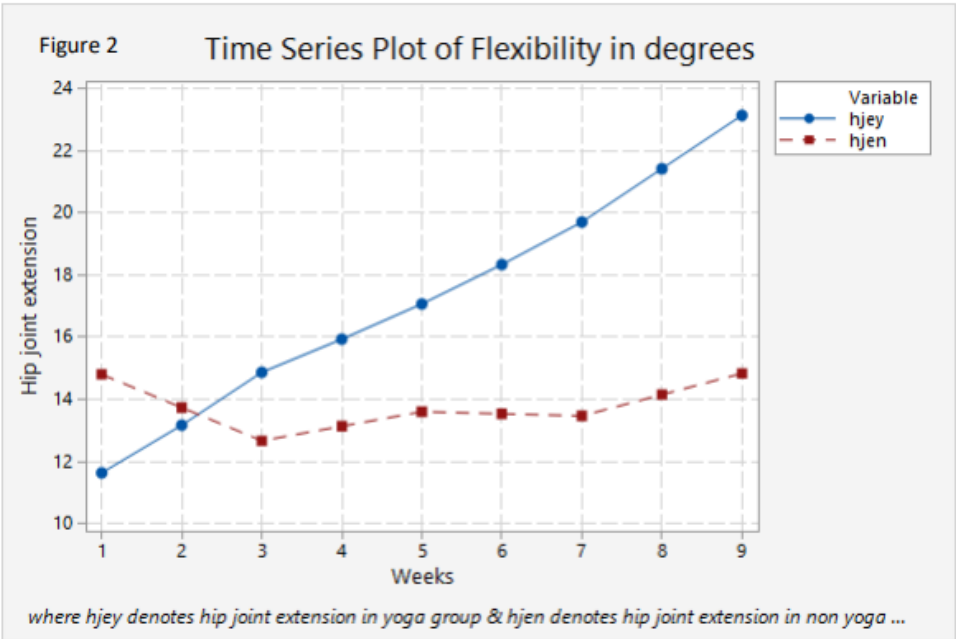


Figure 3: Time Series Plot of flexibility in degrees of Hip Joint Abduction
It shows gradual changes noted in Hip Joint Abduction in both the groups over a period of two months.

FIG 3

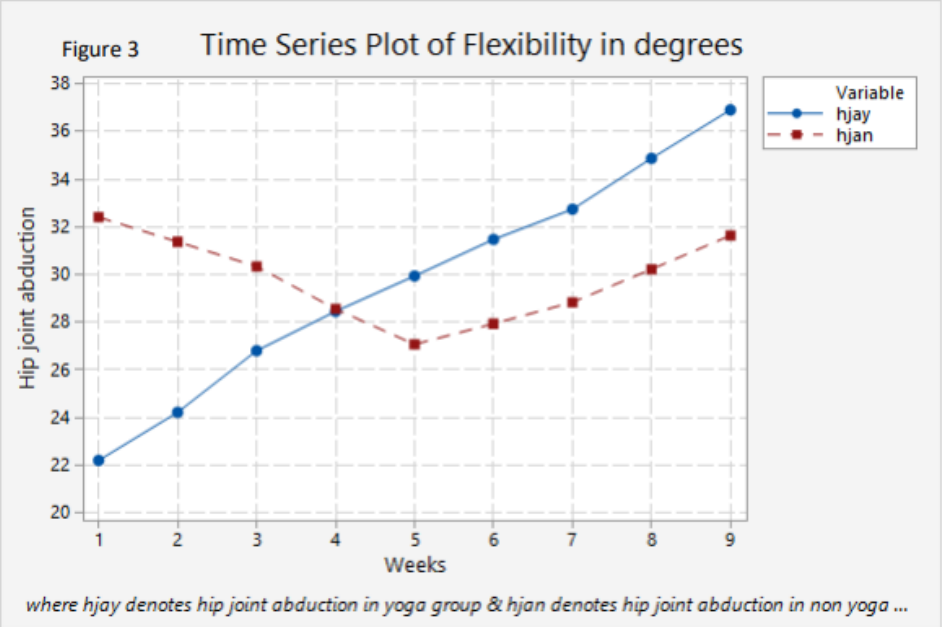


Figure 4: Time Series Plot of flexibility in degrees of Knee Joint Flexion
It shows gradual changes noted in Knee Joint Flexion in both the groups over a period of two months.

FIG 4

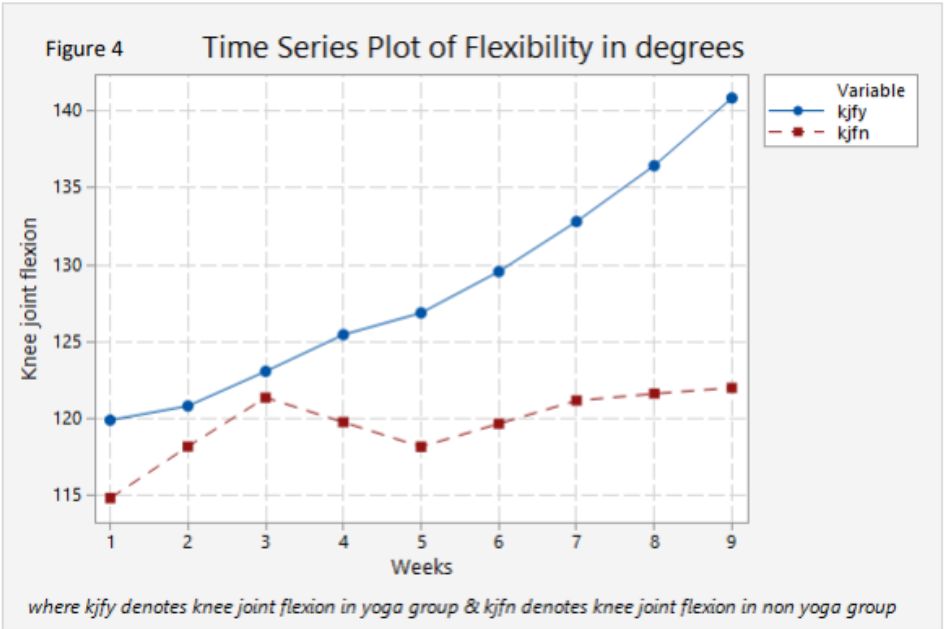


Figure 5: Time Series Plot of flexibility in degrees of Ankle Joint Flexion
It shows gradual changes noted in Ankle Joint Flexion in both the groups over a period of two months.

FIG 5

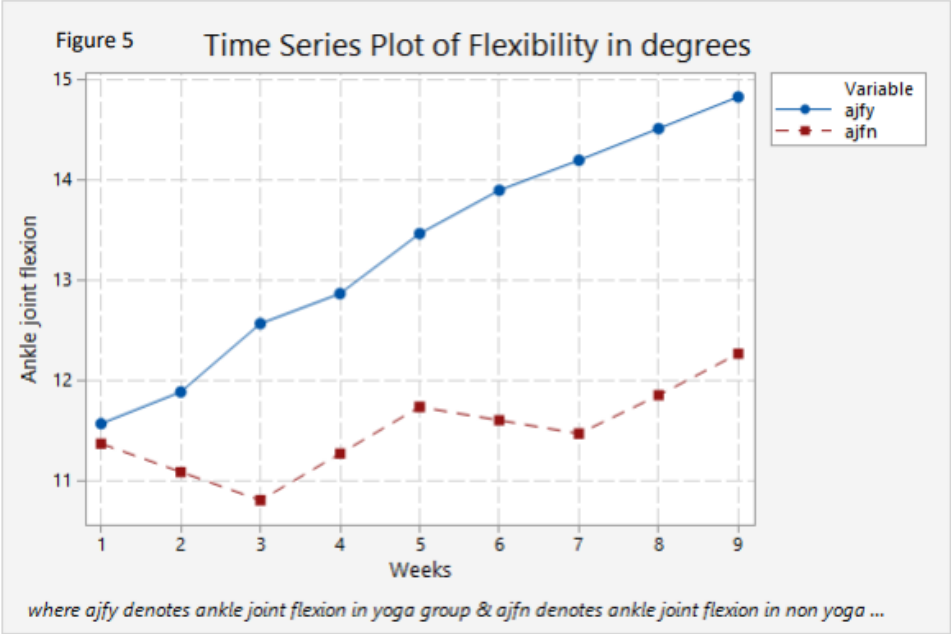


Figure 6: Time Series Plot of flexibility in degrees of Ankle Joint Extension
It shows gradual changes noted in Ankle Joint Extension in both the groups over a period of two months.

FIG 6

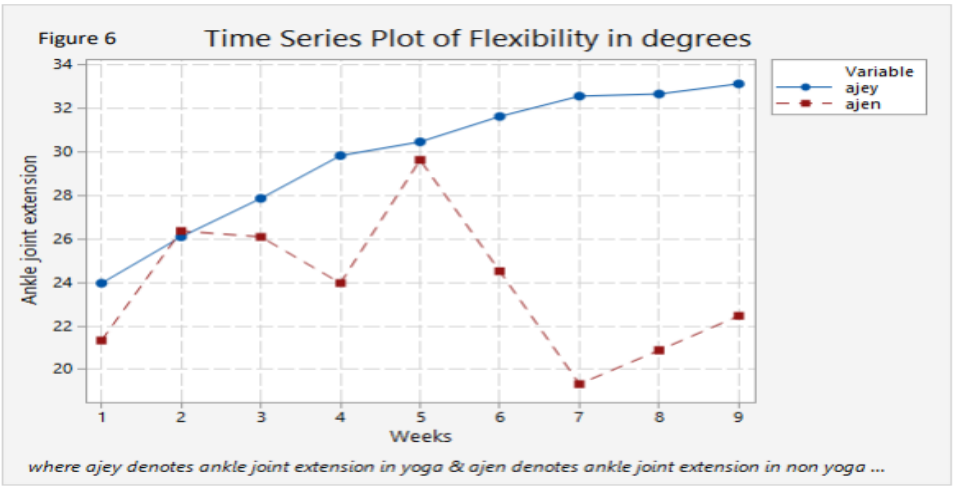


Figure 7: Time Series Plot of skin fold in mm of Front Thigh

It shows gradual changes noted in Front Thigh skin fold in both the groups over a period of two months.

FIG 7

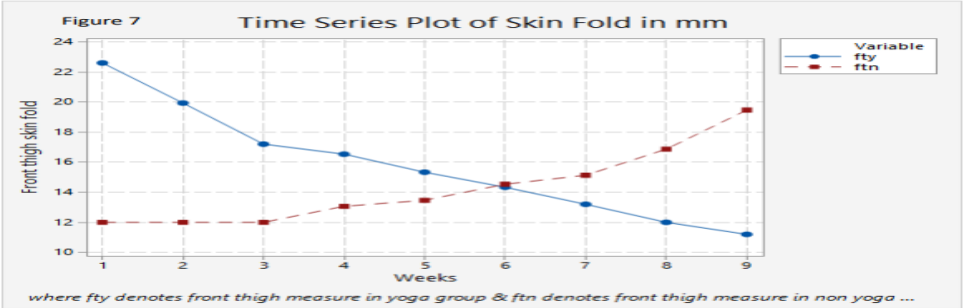


Figure 8: Time Series Plot of skin fold in mm of Mid-Calf

It shows gradual changes noted in Mid-Calf skin fold in both the groups over a period of two months.

FIG 8

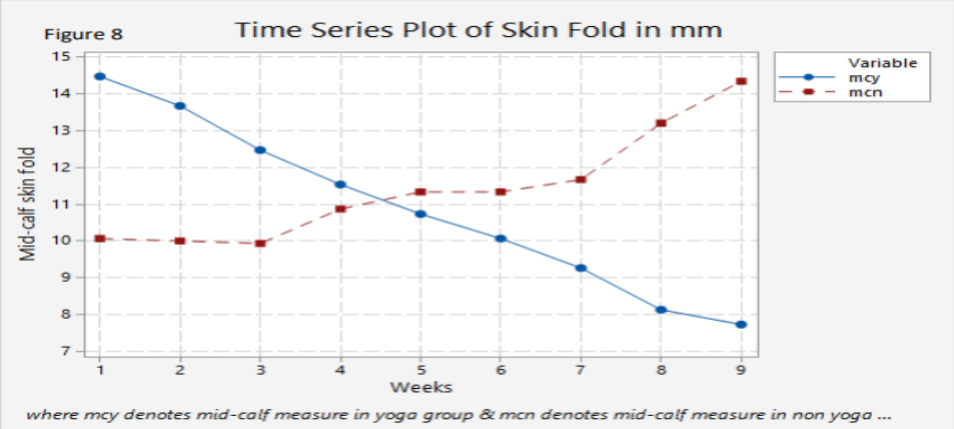
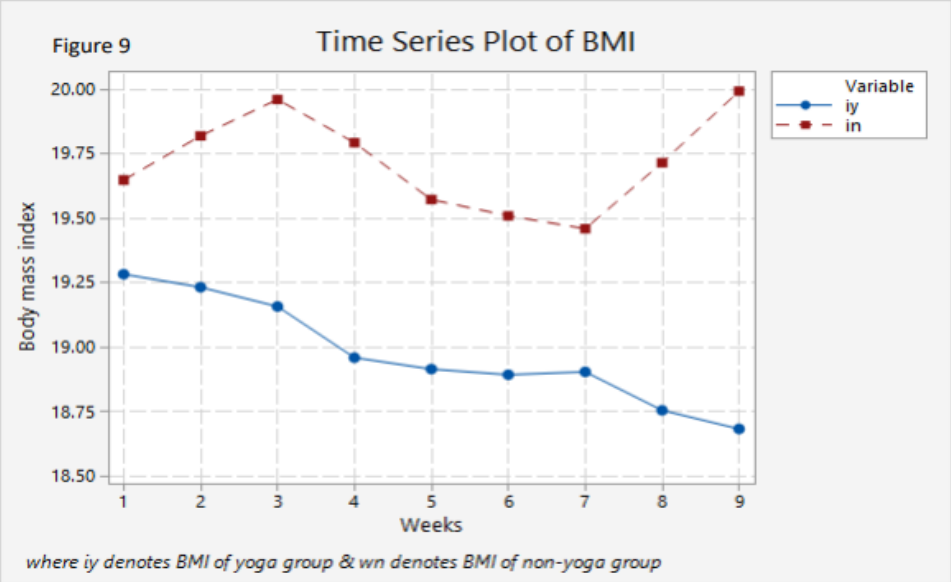


Figure 9: Time Series Plot of BMI

It shows gradual changes noted in BMI in both the groups over a period of two months.

FIG 9



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