A STUDY OF BODY COMPOSITION, BODY TYPE AND SELECTED MOTOR ABILITIES OF FEMALE GYMNASTS IN RELATION TO THEIR PERFORMANCE

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I. INTRODUCTION

A perfect fusion of athletics and aesthetics, gymnasts ranks among the defining sports of the Olympic Games. Mixing strength and ability with style and grace, the high-flying acrobats have provided many of the most breath taking Olympic spectacles of the past quarter-century. Nadia Comaneci's perfect 10 score at the 1976 Montreal Games, the first ever awarded, remains the high-water mark for most gymnastics fans. Gymnastics is highly skilled sport in which performance of the gymnast is evaluated on the basis of technique and difficulty of the skill. The exercise in gymnastics are so technically complex and often executed at such speed that the move is completed before its full impact has been registered on audience (Engel et al, 1980).

In the world of sport, women's artistic gymnastics is an anomaly. Women artistic gymnastics consist of variety of skills on four apparatus i.e. vaulting table, uneven –parallel bars, balancing beam and floor exercise.

Female artistic gymnasts are reported to be a special group in respect of biological development and performance characteristics when compared with female or male athletes representing some other sports events. Women Gymnastics is an unusual blend of sport and art, acrobatics and dance, stiffness and suppleness, flying and crawling, maturity and youth. To its credit, gymnastics has drawn enormous attention from the lay press and from scientists and physicians seeking to understand the sport (Ryan, 1995 and Malina et al, 2006).

In competitive sports every factor has its own bearing on the performance of the player. The components of physique such as size, body fat and lean body mass have been shown to effect physical performance capacity (Gabbett and Georgieff, 2007 and Malousaris et al, 2008). The particular body size, shape and proportion may constitute important pre-requisites for successful participation in many sports. The human body comes in a huge array of different shapes and sizes, but specific body types tend to favour specific sports. By analyzing the build, height and mass, one can discover the most suitable activities for his body and perhaps a hidden athletic talent. Knowing your body type and adapting a routine that matches your dominant genetic predisposition also can mean the difference between fun and frustration.

Gymnastics is a sport that requires ever-increasing and specialized physical abilities. The multi-composition and complexity of the large number of exercises in combination with the diversity of apparatuses demand long, intensive and prolonged specialized training, on a daily basis, from the beginning of the gymnast's career, which starts at an extremely young age. Indeed, relative international sources repeatedly stress the importance of motor capabilities, body composition and aptitudes in order to achieve high performance.

II. METHODOLOGY

The study was conducted on 94 female gymnasts who participated in all India inter university gymnastic championship.

To get the body composition and somatotype the following anthropometric measurements were taken on each gymnast:

Weight, stature, biceps skinfold, triceps skinfold, subscapular skinfold, suprailiac skinfold, calf skinfold, humerus bicondylar diameter, upper arm circumference (flexed), calf circumference.

The following motor ability tests were conducted on each gymnast :

A. Strength Tests

1. Sit-ups (jack knife) (Max. Numbers)
2. Push-ups on ground (Max. Numbers)
3. Chin-ups (Max. Numbers)
4. Standing broad jump (cm)

B. Flexibility Tests

1. Forward bending (Trunk flexion) (cm)
2. Bridge (Trunk extension) (cm)
3. Side Split (Flexibility of hips) (cm)

C. Speed Test

1. 30 metre sprint (sec.)

Competitive Performance :

Marks obtained during the completion was taken as the performance of the female gymnast.

Zero Order Product Moment method of correlation has been applied to compute relationship of variables with competitive performance.

III. RESULT AND INTERPRETATIONS

Table -1: Relationship of Body Composition with Competitive Performance of Female Gymnasts (N=94)

Sr. No	Morphological Variables	Mean SD	Performance Mean SD	Correlation Co-efficient
1	Weight	46.26 4.07	38.47 9.55	-0.201 N.S.
2	Stature	153.18 4.80	38.47 9.55	-0.215*
3	Biceps Skin fold	7.79 240	38.47 9.55	-0.320**
4	Triceps Skin fold	10.51 2.32	38.47 9.55	-0.651**
5	Sub-scapular Skin fold	10.39 2.06	38.47 9.55	-0.457**
6	Calf Skin fold	10.99 1.51	38.47 9.55	-0.570**
7	% Body Fat	22.69 2.42	38.47 9.55	-0.596**
8	% Lean body mass	77.31 2.42	38.47 9.55	0.596**

**Statistically Significant at 0.05 level.*

*** Statistically Significant at 0.01 level.*

N.S. = Insignificant

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Table – II : Relationship of Somatotype Components with Competitive Performance of Female Gymnasts (N=94)

Sr. No	Morphological Variables	Mean SD	Performance Mean SD	Correlation Co-efficient
1	Endomorphy	3.40 0.66	38.47 9.55	-0.536**
2	Mesomorphy	3.70 0.79	38.47 9.55	0.364**
3	Ectomorphy	2.69 0.72	38.47 9.55	-0.041 N.S.

** Statistically Significant at 0.05 level.*

*** Statistically Significant at 0.01 level.*

N.S. = Insignificant

Table – III : Relationship of Selected Strength Tests with Competitive Performance of Female Gymnasts (N=94)

Sr. No	Strength Tests	Mean SD	Performance Mean SD	Correlation Co-efficient
1	Sit-Ups	37.56 13.41	38.47 9.55	0.647**
2	Push-Ups	25.93 9.68	38.47 9.55	0.651**

3	Chin-Ups	8.26 4.36	38.47 9.55	0.721**
4	Standing Broad Jump	183.22 17.56	38.47 9.55	0.593**

* *Statistically Significant at 0.05 level.*

** *Statistically Significant at 0.01 level.*

Table – IV : Relationship Selected Flexibility Tests with Competitive Performance of Female Gymnasts (N=94)

Sr. No	**Flexibility Tests**	**Mean SD**	**Performance** Mean SD	**Correlation Co-efficient**
1	Trunk Flexion	20.09 4.20	38.47 9.55	0.588**
2	Trunk Extension (bridge)	42.48 9.13	38.47 9.55	-0.225*
3	Flexibility or Hips (side split)	6.42 2.60	38.47 9.55	-0.450**

* *Statistically Significant at 0.05 level.*

** *Statistically Significant at 0.01 level.*

Table – V : Relationship of 30 Metre Sprint with Competitive Performance of Female Gymnasts (N=94)

Sr. No	**Speed Tests**	**Mean SD**	**Performance** Mean SD	**Correlation Co-efficient**
1	30 Metre Sprint	5.33 0.16	38.47 9.55	-0.664**

* *Statistically Significant at 0.05 level.*

** *Statistically Significant at 0.01 level.*

Body Composition

Highly significant negative correlations found between skinfolds and performance and between percent body fat and performance at 1% level indicate that less amount of body fat and high amount of lean body mass facilitate a gymnast to lift the weight of the body easily in performing supporting, hanging, swinging and tumbling movements. The gymnast with extra fat will have a lesser amount of relative strength which makes it difficult for the gymnast to work against gravity and move his body through space. Gymnasts must remain on the lean side of lean to be effective competitors at the highest level of competition (Sands et al, 1991 and Claessens et al, 2006).

Somatotyping-

Lean tissue and subcutaneous tissue have important role to play in physical performance as indicated by the results of the present study. The findings on the somatotype ratings indicate a significant negative correlation between endomorphy and competitive performance but significant positive correlation between mesomorphy and competitive performance indicate that gymnasts with a muscular body are able to score more marks. A lower relative fat and lower endomorphy contribute to a greater economy and the higher mesomorphy is positively related with greater dynamic strength. Claessens et al (1999) found a high significant negative correlation between endomorphy and total performance score (r=-0.60). The female gymnasts of the present study are found to be mesomorph-endomorph (3.4-3.7-2.7), however, the findings of the earlier studies found the female gymnasts ectomorphic mesomorph (Claessens et al, 1999). This may be one of the reason of poor performance of Indian female gymnasts at international level.

Motor Abilities

The results of these tests indicate highly significant correlations coefficients between competitive performance and sit-ups, push-ups, chi8n-ups and standing broad jump at 1% level of significance. It indicates that gymnasts with the greater strength relative to their body weight have the advantage for meeting various strength requirements. Nearly every tumbling or skill move on any apparatus requires sheer strength to obtain the momentum for completing the maneuver. Strength is one of the major or redeeming characteristics of gymnastics. Uneven bars require the strong arms, shoulders and abdominal muscles to perform different movements in hang, as well as, in support position. Arm and shoulder strength is important for explosive push-ups on the floor exercises and vaulting table. A considerable force output is required in the shoulder girdle muscles during

gymnastic exercises. Ann et al (2007) also found the elite adolescent gymnasts to possess strong scapular muscles. Leg strength is required for explosive take-off on vaulting table. Tumbling movements, such as double saltos, double twisting also require explosive take off to perform technical correct movements.

Highly significant correlations of three selected flexibility tests with competitive performance ($p<.01$) are observed from the study. Suppleness in all joints is essential to achieve the maximum possible range of movement. Numerous gymnastics move are specially designed to display the flexibility of the gymnast. The stretch ability of the spine plays important role in performing bending move. The execution of many elements such as forward walk over and back walk over depends purely on flexibility of the trunk. Leg flexibility is required to execute scales, leaps, stradlers and many more elements on floor, balancing beam and uneven bars. Gymnast also requires flexibility to learn skills and then to perform them with wider amplitude, which is a key factor in gymnastic judging.

The findings of the present study show high significant negative correlation of speed with gymnastic performance. It means if time taken by the gymnast to complete 30 metre sprint is more her performance is less. Sprinting ability is the most determinant factors for a better performance in vaulting. Research to date has demonstrated the importance of running speed and an accurate take off on gymnastics vaulting performance. Murray (1979) described that the all around gymnast must be extremely flexible, must possess stronger arms, shoulders, upper and lower back and abdomen than the average female gymnast. A gymnast of the right proportions will find it easier to make progress than those, who lacks certain characteristics.

It is apparent from the study that body composition, body type, strength, speed, flexibility are contributing factors in gymnastics performance.

IV. CONCLUSION

1. The analysis of data pertaining to the body composition conclude negative and significant correlation of percent body fat with total gymnastics score whereas, lean body mass percentage demonstrate positive significant correlation.
2. There is significant relationship of somatotype components with gymnastic performance. The first component (endomorphy) is correlated significantly but negatively, whereas, the second component (mesomirohy) show positive significant correlation with the total performance score.
3. The motor abilities selected for the present study are significantly correlated with gymnastic competitive performance. The selected arm, shoulder, abdomen and leg strength tests (sit ups, push-ups, chin ups, standing broad jump) show significant relationship with total performance and apparatus performance.
4. On flexibility variable, all the selected three tests (trunk flexion, turnk extension and flexibility of hips) are significantly correlated with competitive performance.
5. The analysis of data pertaining to the sprinting ability (30 metre sprint) of the gymnast show significant correlation with gymnastic performance.

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