Chapter II

REVIEW OF RELATED LITERATURE

An attempt has been made by the scholar to locate literature related to the study. The relevant studies of specific importance are cited as follows:

Clarke and Schope\(^1\) in their study of a strength test for boys 9 through 12 years of age in grades IV, V and VI was based upon cable tension strength tests. From 18 cable tension strength tests, the following four were selected by multiple correlation procedures: shoulder extension, trunk extension, knee extension and ankle plantar flexion (ankle extension). The total of the four tests were designated the strength composite, utilizing Roger's method in the construction of strength index norms; the subjects were 826 boys from ten communities located in various parts of Oregon.

Zuti and Corbin\(^2\) conducted a research on physical fitness norms for college freshmen in which 3000 freshmen of Kansas State University, within the age from 17 to 19 years were taken into consideration. The

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\(^1\)H. Harrison Clarke and Theodoreg Schope, "Construction of a Muscular Strength Test for Boys in Grades IV, V, VI," Research Quarterly 3 (December 1962): 515.

study was conducted to measure the strength, flexibility, body composition and cardio-vascular fitness. The results indicate that the college freshmen at the University were above average than the standards which were appropriate for use by the Americans.

Bitcon\(^3\) constructed norm tables for grade 9-12 by taking four physical fitness items, as pull ups, two minutes sit-ups, standing broad jump and 300-yard shuttle run. It was found significantly valid with AAHPER fitness test score.

Fukushima\(^4\) concluded that flexibility is an important and essential component of physical conditioning in gymnastics.

Pauline\(^5\) explained that it required a great deal of strength in almost all parts of the body, specially in back, legs, stomach and shoulders. She further asserted that a gymnast may perform all the movements easily without strain, if she possessed sufficient strength.

Bosco\(^6\) reviewed the physical and physiological characteristics

\(^3\)Lawrence E. Bitcon, "Validation of a Four Item Fitness Test and Norms for Higher Schools Boys in the State of Iowa," Completed Research in Health, Physical Education and Recreation 8 (1965): 7.


of champion male gymnasts and concluded that champion gymnasts possess less superficial fat, a higher centre of gravity, more strength, and higher amount of explosive power, reaction time and balance etc.

Colley\textsuperscript{7} developed a muscular strength test battery for college women to determine the best combination tests to evaluate over all body strength and to examine various anthropometric measurements and body indices to determine in the construction of normative scale for the over all body strength test battery. He concluded that strength factors and anthropometric measures were highly significant and the factors could be considered in the construction of normative scale for the strength test battery.

Twelve Indian Junior National Basketball players who participated in Asian Junior Basketball Championship were tested on three specific field tests for measuring specific fitness for the game by Malhotra and others\textsuperscript{8}. They revealed that selected field tests were found significant to predict skill efficiency and specific fitness tests were highly correlated with competitive performance.

Cable\textsuperscript{9} conducted a study with 30 test items of 183 girls' subject


and constructed a motor fitness test battery. In his motor fitness test
battery items were muscular strength, cardio-vascular endurance, flexibili-
ity, agility, balance and power. The 30 test items were not true measures
of motor fitness as only 63% of the total variance were result oriented.

Shore Jr. 10 constructed a test battery for assessing motor fitness
for boys in the lower elementary grades. Seven factors were revealed and
two test batteries were formed. Test battery included were Clarke's
Strength Composite, McCloy's Endurance Ratio, Well's Sit and Reach Test,
Leg Flexion-Extension etc. The battery two was made of three hundred
yard run, balance on stick, flexibility test, modified push-up etc. Both the
motor fitness test batteries for elementary grades were highly valid.

Watson 11 prepared test items for the physical fitness tests
consisting of long jump or vertical jump, 50-Yard dash, sit-up, stick jump
and 300-Yard distance run. The norms were established for each test item
for girls and boys according to chronological age. Percentile tables were
constructed based on the results of investigation. Watson further recom-
ended that in elementary level, there should be some test items and norms
to evaluate shoulder girdle strength.

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10 John Roger Shore Jr. "The Construction of a Motor Fitness
Test Battery for Boys in the Lower Elementary Grades," Dissertation

11 Rick E. Watson, "The Establishment of Norms for the Nebraska
Physical Fitness Test," Completed Research in Health, Physical Education
Maglischo\textsuperscript{12} studied twelve anthropometric measures and 23 derived indices in his study of 72 girls at each level along with 25 Cable-tensiometer strength tests. The indices and strength criterion measures were inter-correlated with each other. He concluded that anthropometric measures inter-correlated higher for elementary school girls, but the indices were higher at the junior and senior high school levels than that of the elementary level. The strength tests were selected to represent the muscles activating the various joints of the body and muscles involved in several movements of the joints. He included many specific tests as wrist flexion, elbow flexion, etc. He also concluded that all anthropometric measures and indices were significantly related with maturity, strength and several motor elements.

Cumming\textsuperscript{13} reported that in four of the six events, explosive power and muscular strength are required for approximately 30 seconds as the gymnast controls his total body weight with his hands in either support or hanging position. These demands are such that gymnasts at high level are among the leanest, strongest and most flexible of all athletes.


Loken and Robert\textsuperscript{14} have mentioned that many balances call of muscular action for support particularly of abdomen and shoulder.

Stuart\textsuperscript{15} in his study also stated that the correct ratio of strength and weight, that is relative strength, helps in performing the appropriate movement in gymnastics.

Cureton\textsuperscript{16} in his study reported that gymnasts demonstrate much more flexibility than other sports especially in trunk flexion and extension. Flexibility exercises are more conducive to build endurance in movements like acrobatic, tumbling and combination exercises on different apparatus.

According to Baley\textsuperscript{17} good flexibility is essential for the development of skill in gymnastics, as resistance from muscles, tendons and ligaments will be minimised.


\textsuperscript{17}James A. Baley, "Improving Flexibility," Hand Book of Gymnastics (Sydney: Allyn and Bacon, 1977), p. 64.
Jenson and Fisher\(^{18}\) stated that a high degree of total body flexibility is desirable and un-usual amount of flexibility in certain body movement is necessary for maintenance of currect body form in gymnastics.

McIlroy and Charles\(^{19}\) stated that the learner must have muscular strength adequate for the performance of the task. For example, a person who lacks enough strength to pull himself up by his arms or to flex the thigh forward on the trunk against the resistance of gravity and centri-fugal force could not succeed in learning to perform difficult exercises on the Horizontal Bar, the Parallel Bars, the Horizontal Ladders or the Flying Rings.

Zacizosky\(^{20}\) has illustrated with examples that in gymnastics the relative strength i.e. Maximum strength divided by body weight is more important.

Harre\(^{21}\) pointed out that flexibility is a primary prerequisite qualitatively and quantitatively, for good execution of the movement. He


further stated that the lack of flexibility can result in difficulty in learning new elements, injuries, incomplete expression of conditional abilities i.e. strength, speed endurance, their complex form and coordinative ability, coupling ability and agility.

Locken and Willoughby\textsuperscript{22} emphasizing the requirement of flexibility of shoulders, hips and other parts state that a gymnast must be able to do the split front as well as side split with ease. The back must be strong and flexible in order to work for forceful exercise such as vaulting. Gymnast must have extreme range of movements in ankle for pointing-out the toes. The wrist and hand must be very flexible and strong to work on every piece of equipment.

McKinney\textsuperscript{23} designed a motor fitness test for use in evaluating under-graduate male physical education majors. Test items were administered to 128 under-graduate male physical education majors, and the resultant data were factors analyzed according to the principle axes method with varimax criterion for rotation. Two test batteries containing five items each were developed on the basis of the rotated factor loading of the test items. Test battery contained the highest loading test items for each factor identified, and included the following five measures:

\textsuperscript{22}Newton C. Loken and Robert J. Willoughby, The Complete Book of Gymnastics, p. 47.

1. Time Unit Shuttle Run
2. Cable Tension Strength Total
3. 10-Yard Dash
4. Thigh Flexion Flexibility, and
5. Rogers Physical Fitness Index.

Test Battery II contained five administratively feasible test items which had high factor loading and could be administered indoor and included the following items:

1. Time Limit Shuttle Run
2. Ankle Planter Flexion Strength
3. Thigh Flexion Flexibility and

McKinney\textsuperscript{24} developed a two seven item test batteries consisting of measures which had the highest rotated factor loading. Test battery I contained the highest loading test item on each of the seven factors and included the following seven measures:

1. Time Limit Shuttle Run
2. 30 Feet Shuttle Run
3. Cable Tension Strength Test for College Women
4. Head Flexion

5. Bench Push-ups
6. Bass Length-wise Stick Test, and

Test Battery II was developed to offer greater administrative feasibility than test battery I. The items contained in this test battery included - a) Time Limit Shuttle Run, b) 30- Feet Shuttle Run, c) Ankle Planter Flexion Strength Test, d) Head Flexion, e) Bench Push-ups, f) Bass Length-wise Stick Test, and g) 50-Yard Dash.

Neely\textsuperscript{25} cable tension strength tests 25 and 36 anthropometric measures were obtained from girls in each grade from 4 to 12. The following strength tests were selected that would adequately reflect the total musculature for upper elementary school girls; shoulder extension, hip extension and trunk flexion, for junior high school girls, shoulder extension, hip flexion, and ankle planter flexion. In the study, scores on the selected strength tests, age, and weight were obtained from 124 girls in each grade, 372 at each school level, 1116 over all. Norms were constructed following Roger's method of constructing strength index norms.

Netaji Subhas National Institute of Sports, Patiala\textsuperscript{26} has prepared norms for general physical fitness for various sports. These norms were made for sportsmen/women in general and no differentiations were made regarding different sports. In gymnastics physical fitness norms were prepared for women and the different motor traits selected are standing broad jump, standing vertical jump, push ups, flexed arm hang, sit-ups, grip strength, back strength, 60-M. dash, trunk flexibility and shuttle (6 x 10 M.). The norms were classified as poor, average, good and very good.

Walia\textsuperscript{27} (1981) conducted a study on 42 men gymnasts who had participated in Senior National Gymnastics Championship in 1981. He has reported a significant correlation between competitive performance on one hand and certain physical abilities (arms strength, abdominal strength and explosive legs strength) on other hand. Further he divided the group of 42 gymnasts into three sub-groups on the basis of competitive performance. He has reported that the best group in competitive performance was also better than other two groups in arms strength, abdominal strength, leg strength and grip strength.

\textsuperscript{26}\textit{Physical Fitness Norms for National Sportsmen and Sportswomen. Netaji Subhas National Institute of Sports, Patiala, 1982.}

Debnath\textsuperscript{28} (1983) has reported a significant relationship between competitive performance in women gymnastics on one hand and physical abilities (arm strength, sprinting ability, abdominal strength and grip strength differential ability) on other hand. She administered 50-M. sprint, sit-ups and pull-ups on uneven bars to measure sprinting ability, abdominal strength and arms strength respectively. She has also reported a significant difference in arm strength, speed, abdominal strength and endurance between top class 13 women gymnasts and 14 poor gymnasts of Trial Games held at Delhi in 1982.

Walia\textsuperscript{29} (1985) conducted study on 50 gymnasts to prepare the norms pertaining to physical and physiological abilities in gymnastics for men section. He conducted the following tests to form norms.

1. Strength Endurance
   a) Pull-ups on Horizontal Bar (Maximum Numbers)
   b) Push-ups on Parallel Bars (Maximum Numbers)
   c) Leg Raising on Wall Bars (Maximum Numbers)

2. Static Grip Strength
   a) Left Grip Strength
   b) Right Grip Strength


3. Explosive Strength
   a) Medicine Ball Throw
   b) Jack Knief (Maximum Number in 10 seconds)
   c) Sargent Jump

4. Flexibility
   a) Shoulder Flexibility
   b) Trunk Flexibility
   c) Hip Flexibility

5. Technical Tests
   a) Round-off on Floor
   b) Sissors on Pommel Horse
   c) Forward Uprise on Parallel Bars
   d) Hip Circle to Hand-stand on Horizontal Bar
   e) Hand-spring on Vaulting Horse
   f) Kip to "L" on Rings

Walia formed norms for all these tests in five categories i.e. very-poor, poor, average, good and very good. He has also reported that best group was better than mediocre and the poor groups in Sargent Jump, Leg Raising on Wall Bars and Hip Flexibility and reported a non-significant difference in all other variables.

In this chapter, the scholar has emphasised and presented all relevant studies. The scholar could not locate any specific studies related to specific fitness norms in women gymnasts in India. Hence the present study of constructing specific fitness norms in women gymnastics is the first attempt in India by the scholar, thus, it will be an added advantage to the field of Gymnastics in India.