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REVIEW ARTICLE

NORMS TO EVALUATE GYMNASTICS PERFORMANCE OF 4–5 YEARS CHILDREN

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ABSTRACT

The purpose of the study was to design and develop norms for Gymnastics of 4- 5 years children of West Bengal. There were 264 subjects who were beginners in Gymnastics already introduced to basic skills. No gender-wise grouping was done. The subjects were trained for 5 days a week, for 2 hours and for 36 weeks. After 9 months of training period, competition was conducted with an aim to collect data for the study. To test the reliability, a retest was conducted after 1 week of 15 subjects from the same group who were selected randomly. The descriptive statistics of the different parameters was found out by calculating mean and the variability was expressed by standard deviation. Correlation was analysed to test the reliability through the test-retest method. Finally, z-score of the data was calculated to develop the norms in Gymnastics for 4 to 5 years children of West Bengal by using the Z-scale. The norms for Floor Exercise of 4 to 5 years children, out of 20points designed from the z-scores of final scores as Very Good > 14.65, Good: 10.94 – 14.64, Average: 7.24 – 10.93, Below Average: 3.53 – 7.23 and Poor<3.53. The wide diversity of movements and positions makes it viable for children to develop a fund of quality sensory and motor pathways and make a positive stimulant on their psychosomatic status.

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INTRODUCTION

Gymnastics has its initiation from simple events assessing the ability of a person to run, jump, swim, throw, wrestle, and climb ropes and weight lifting to a sport of speed, agility, grace and acrobatics (Devasthali *et al*. 2016). It is a sport which requires physical strength, flexibility, power, agility, coordination and balance and demands lot of courage, stamina and mental potentiality. In the current era, Gymnastics comprises of an immense variety of movements on different apparatus and calls for displaying brilliance, greater skill and knowledge and an ability to combine both harmoniously. Gymnastics is a sport involving the performance of movements that contribute to the development of the arms, legs, shoulders, chest and abdominal muscle groups. Mental traits like alertness, precision, daring, self-confidence and self-discipline can also be developed through gymnastics (Loken, N.C. & Willoughby, R.J., 1977). In India, children start practicing Gymnastics from the age of 4 years or even less. As per the existing 'Code of Points' of 'Gymnastic Federation of India', a gymnast starts competing from the age of 8 years. The present study was conducted since the researcher felt the necessity of an effective and focused training structure and an uniform evaluation process for the young gymnasts at the beginners' level in West Bengal, India that would provide guidance to judges and various professional trainers who have not under gone formal training like, N.I.S. Coaching course, diploma or any Government or FIG or GFI recognized coaching courses, but impart coaching to gymnasts of beginner's level in different clubs and institutions in the city as well as in the suburbs.

Thus, training given to children of West Bengal in Gymnastics is inadequate for the development of necessary skills in gymnastics. After the thorough review of related literature, the researcher did not find any 'Code of Point' or norms in Gymnastics for children of4-5 years to evaluate the level of performance. So, the researcher intended and formed the norms for this age category.

Purpose of the study: The purpose of the study was to design and develop norms to evaluate Gymnastics performance of 4-5 years children of West Bengal. The basic principle which was followed for selection of subjects was – the subjects should be the true representatives of gymnastics fraternity. The subjects were from different districts of West Bengal, India like, Kolkata, North 24 Parganas, South 24 Parganas, Howrah, Hooghly, Nadia, Siliguri, Burdhaman, Malda, Midnapore, Bankura and Murshidabad. There were 264 subjects who were all beginners in Gymnastics already introduced to basic skills. No gender-wise grouping was done as they performed similar skills on the same apparatus, that is, Floor Exercise. To figure out the sample size, Sloven's Formula has been used (Sloven-Daniel, 1999), which is written as: -

$n = N / (1 + Ne^2)$

Where;n = Number of samples,
N = Total population and
e = Error tolerance (level)
Here,

N = 800(approximate total no. of gymnasts presents in West Bengal in specific age group as informed by 'Bengal Amateur Gymnastics Association')

e = 0.05 (95% level of significance)
So,
$n = 800/ (1+800x\ 0.05^2)$
= 800/3
= 266.666
= 267(approximately)

The normality of the sample which was tested by Shapiro-Wilk method was 0.737 and was significant at 0.05 level, indicates that the data values are collected from a normally distributed sample and hence represents the population. Also, the range of height and weight of the subjects were 93.98 – 103.22 cm and 15.90 – 21 kg, respectively.

METHODOLOGY

For the present study, the subjects were trained for 5 days a week for 2 hours for 36 weeks. After 9 months of training period, competition for the4-5 years age group wasconducted with an aim to collect data for the research. To test the reliability, a retest was conducted after one week for 15 subjects from the same group who were selected randomly. In order to validate the developed design and the norms, few eminent expert opinions were taken and also certified the same. Different statistics were applied in order to determine the norms.

Reliability and Validity: Correlation was analysedto test the *reliability* through the test-retest method. The criteria considered for the design of the norms for 4-5 yearswas*validated* by four experienced and qualified eminent personnel from gymnastics fraternity, who were F.I.G. certified level-II coach, the Chief coach and other coaches of Gymnastics of 'Sports Authority of India' (Eastern Region) and 'Gymnastics Federation of India' certified judges and ex-judges. Among them one of the experts was a former International gymnast and others experts were all former National level gymnasts. Table-2 describes the Correlation Coefficient for Test and Re-testscores for Floor Exercise of 4- 5yearsage group in points where, the correlation coefficient of*D-score* was 0.89, *E-score*was 0.88, *Start Value*was 0.94, *Average E-score*was 0.04 and *Final score*was 0.95, respectively. Among them all the scores were significant at 0.05 level, except for Average E-score.

The Evaluation Method: According to 'Code of Point' of F.I.G. (2021-2024) the 'final score' is attained by calculation of the Difficulty Value or Score of the skills performed by a gymnast as well as scrutinizing the occurrence of faults in the entire performance to decide the Execution Value or Score along with any applicable neutral deductions.

Determination of the Final Score in Gymnastics is as following:

Final Score = [Difficulty Value + Execution Value] - Any Applicable Neutral Deductions

=[D-score +E-score] - Neutral Deductions
=10 points + 10 points
=20 points

where,

D-score = Difficulty Value (D.V.) + Composition Requirement (C.R.) + Bonus
E-Score = Deductions are made for errors and faults in technique and execution

Neutral deductions = Short Exercise & Other Applicable general faults. For this study, the D-Panel judges deducted the following appropriate neutral deduction (penalty) for a ***Short Exercise*** from the Final Score: -

1 For performance of 7 and more elements - no deductions applicable.
2 For performance of 6 elements - deduction of 2.00 points.
3 For performance of 5 elements - deduction of 3.00 points.
4 For performance of 4 elements - deduction of 4.00 points
5 For performance of 3 elements - deduction of 5.00 points.
6 For performance of 2 elements - deduction of 6.00 points.
7 For performance of 1 element - deduction of 7.00 points.
8 For no elements - deduction of 10.00 points.

The 'Code of Point' as per 'Fédération Internationale de Gymnastique' has been considered and modified for identifying the items to be considered for applicable neutral deductions and the general faults and penalties by E-panel judges.

Value of each element / skill = 1.00 point: Therefore, total difficulty value (D.V.) = 7.00 points

Other general deductions as described in TABLE 3, 4 and 5.

RESULTS AND DISCUSSION

In the age category of 4-5 years, gymnasts or the subjects performed only one apparatus/event, namely, *Floor Exercise* where boys and girls performed the same routine of skills. Their performance was evaluated out of 20 points and statistically analysed as described in the following section. The raw data was analysed following the standard statistical techniques for 4-5 years on Floor Exercise. The descriptive statistics of the different parameters in this age group was found out by calculating mean and the variability was expressed by standard deviation. Correlation was analysed within the various age groups to test the reliability through the test-retest method. Finally, z-score of the data was calculated to develop the norms for 'Code of Points' in Gymnastics for 4 to 5 years children of West Bengal, India by using the Z-scale. The above table depicts the testing of normality of the sample using the Shapiro-Wilk method (Sapiro& Saleh, 2012) and the level of significance was considered at 0.05 level, which indicates that the data values are collected from a normally distributed sample and hence represents the population. According to Table-10, the Mean value and Standard Deviation for Floor Exercise of 4- 5 years age group, the *D-score* was 6.02± 1.50 points, *E-score* was 5.51±1.72 points, *Start Value* was 11.53±3.10 points, *Average E-score* was 2.44±0.63 points and *Final score* was 9.09±3.09 points, respectively. The Maximum Valueand Minimum Value of the *D-score* was 9.00 and 2.00 points, *E-score* was 10.00 and 2.00 points, *Start Value* was 19.00 and 4.00 points, *Average E-score* was 4.20 and 1.25 points and *Final score* was 16.75 and 1.65 points, respectively.
Table 11 present the Standard Scores or z-scores with a range from -2.68 to +1.98 which reveals that all the data scores were within normal distribution of limits of z, that is, ±3. Table 12 present the Standard Scores or z-scores with a range from -2.04 to +2.61 which reveals that all the data scores were within normal distribution of limits of z, that is, ±3. Table 13 present the Standard Scores or z-scores with a range from -2.43 to +2.41 which reveals that all the data scores were within the normal distribution of limits of z, that is, ±3. Table 14 present the Standard Scores or z-scores with a range from -1.88 to +2.78 which reveals that all the data scores were within normal distribution of limits of z, that is, ±3. Table 15 present the Standard Scores or z-scores with a range from -2.41 to +2.48 which reveals that all the data scores were within normal distribution of limits of z, that is, ±3. The gymnasts of 4^+ - 5 years age category performed only on Floor Exercise and the evaluation of performance was done out of 20 points.

Table 1. The criteria measured for 4 - 5 years age group on Floor Exercise

APPARATUS	CRITERIA
Floor Exercise	Forward roll, Backward roll, Standing arch, Leg split sitting, T-balance (2seconds hold), Handstand, Straddle roll For Bonus:From handstand 3/4th turn to cartwheel
Apparatus Specification: AREA: (200 cm X 1500 cm)	

Table 2. Depicts the Correlation coefficient of D-score, E-score, Start Value, Average E-score and Final Score for the reliabilityof4- 5years age group for Floor Exercise

GROUP 4+-5 years	D- Score	E- Score	Start Value	Average E-Score	Final Score
" r " " p "	0.89 (0.00001)*	0.88 (0.000018)*	0.94 (0.00001)*	0.04 (0.878503)	0.95 (0.00001)*

* significant at 0.05 level

Table 3. Represents the applicable neutral deductions

BY D-PANEL JUDGES						
FAULTS		**Small**	**Medium**	**Large**	**Very Large**	**Remarks**
		0.10	**0.30**	**0.50**	**1.00 or more**	
Failure to land feet first or in prescribed position from an element	Each time	-	-	-	-	No D.V., No C.R.
Spotting assistance *(help)*	Each time	-	-	-	x	No D.V. No C.R.
Non-permitted presence of spotter	Gymnast per event	-	-	X	-	From Final Score

D.V. - Difficulty Value; C.V. - Connection Value; C.R. - Composition Requirement; x: Applicable Deduction

Table 4. Depicts the general faults and penalties considered by E-Panel judges

BY E-PANEL JUDGES			
FAULTS	**Small**	**Medium**	**Large**
	0.10	**0.30**	**0.50**
EXECUTIVE FAULTS (for each time)			
– Bent arms or bent knees	*	*	*
– Leg or knee separations	*	* shoulder width or more	-
– Legs crossed during elements with twist	*	-	-
– Insufficient height of elements *(external amplitude)*	*	*	-
Insufficient – exactness of tuck or pike position in single salto	* 90° Hip angle	*>90° Hip angle	-
– Failure to maintain stretched body posture (*piking too early)*	*	*	-
– Hesitation during performance of elements & movements	*	-	-
– Attempt without performance of an element (*empty run)*	-	*	-
– Deviation from straight direction	*	-	-
Body and/or leg position in elements: – Body alignment – Feet not pointed/relaxed – Insufficient split in acro elements	* * *	- *	-
– Failure to fulfil technical requirementsin Elements	*	*	*
– Precision	*	-	-
– Performance of Dismount too close to the apparatus	-	*	-
LANDING FAULTS (all elements including dismounts)	If there is no fall the maximum landing deduction may not exceed 0.80		
– Legs apart on landing	*	-	-
– Extra arm swings	*		-
– Lack of balance	*	*	-
– Extra steps, slight hop	*	-	-
– Very large step or jump *(guideline – more than 1 meter)*	-	*	-
– Body posture fault	*	*	-
– Deep squat	-	*	-
– Support on mat/apparatus with 1 or 2 hands	-	-	*
– Fall on mat to knees or hips	-	-	*
– Fall on or against apparatus	-	-	*
– Failure to land feet first on landing from element	-	-	*

*Applicable deductible points

Table 5. Represent the Difficulty Values (D.V.) for Floor Exercise along with its specific deduction for 4 to 5 years

Floor Exercise (D.V.) Area: (200 X 1500) c.m.		**SPECIFIC DEDUCTION**	**0.1**	**0.3**	**0.5 (fall)**
1	Forward Roll	•Head touches first	x	x	-
2	Backward Roll	•Knee width (one shoulder wide)	<	>	-
3	Standing Arch	•Lack of arch	x	x	-
4	Leg Split Sitting	•Insufficient split •Legs in split are not parallel	x x	x x	- -
5	T-Balance (2 Seconds Hold)	•Lack of balance/stretching •Hold	x <2 sec	x <1 sec	- -
6	Handstand (Momentary – 1 Second Hold) #	•Legs not together •Incomplete handstand	x x	x x	- -
7	Straddle Roll	•Body posture •Insufficient stretch	x x	x x	- -

xApplicable deductible points

Table 6. Represent the composition requirement for Floor Exercise of 4to 5 years

COMPOSITION / SPECIAL REQUIREMENT (C.R.)		
1	STANDING ARCH	0.50
2	LEG SPLIT FWD SITTING	0.50
3	T-BALANCE	0.50
4	HANDSTAND MOMENTARY #	0.50
TOTAL POINTS		2.00 Points

Table 7. Represent the bonus for Floor Exercise of 4 to 5 years

BONUS	1.00 POINT EACH
# Bonus will be awarded instead of Handstand Momentary, if 3/4 turn to cartwheel from handstand momentary is performed	

Table 8. Represent the 'Final Score' for Floor Exercise of 4 to 5 years

FINAL SCORE	
D-SCORE	DIFFICULTY 7.00 C.R. 2.00 BONUS 1.00 10.00 Points
E-SCORE	10.00 Points
TOTAL	20.00 Points

Table 9. Represents the testing of the normality of the sample

GROUP	APPARATUS	SHAPIRO-WILK		
		Statistic	Degree of Freedom	Significance
4-5 years	Floor Exercise	.967	264	0.737*

* significant at 0.05 level

Table 10. Mean, standard deviation (S.D.), maximum value & minimum value of D-Score, E-Score, Start Value, Average E-Score and Final Score (in points) of 4- 5years age group for Floor Exercise

	Category	Mean ± S.D.	Maximum Value	Minimum Value
Floor Exercise	*D-Score*	6.02 ± 1.50	9.00	2.00
	E-Score	5.51 ± 1.72	10.00	2.00
	Start Value	11.53 ± 3.10	19.00	4.00
	Average E-Score	2.44 ± 0.63	4.20	1.25
	Final Score	9.09 ± 3.09	16.75	1.65

Table 11. The respective z-score of D-Score with respect to its raw score (in points) of4- 5years age group for Floor Exercise MEAN=6.02S.D.= ±1.50

Raw Score	z score	Raw Score	z score	Raw Score	z score	Raw Score	z score
2.00	-2.68	4.50	-1.01	7.00	0.65	9.00	1.98
3.00	-2.01	5.50	-0.35	7.50	0.98		
3.50	-1.68	6.00	-0.02	8.00	1.32		
4.00	-1.35	6.50	0.32	8.5	1.65		

Table 12. The respective z-score of E-Score with respect to its raw score (in points) of4- 5years age group for Floor Exercise MEAN=5.51S.D.= ±1.72

Raw Score	z score	Raw Score	z score	Raw Score	z score
2.00	-2.04	6.00	0.29	10.00	2.61
4.00	-0.88	8.00	1.45		

Table 13. The respective z-score of Start Value with respect to its raw score (in points) of4- 5years age group for Floor Exercise MEAN=11.53S.D.=±3.10

Raw Score	z score	Raw Score	z score	Raw Score	z score	Raw Score	z score
4.00	-2.43	9.00	-0.82	11.50	-0.01	14.50	0.96
7.00	-1.46	9.50	-0.65	12.00	0.15	15.50	1.28
7.50	-1.30	10.00	-0.49	12.50	0.31	16.00	1.44
8.00	-1.14	10.50	-0.33	13.00	0.47	16.50	1.60
8.50	-0.98	11.00	-0.17	14.00	0.80	19.00	2.41

Table 14. The respective z-score of average E-Score with respect to its raw score (in points) of4- 5years age group for Floor Exercise

MEAN=2.44S.D.=±0.63

Raw Score	z score	Raw Score	z score	Raw Score	z score	Raw Score	z score
1.25	-1.88	1.95	-0.77	2.65	0.33	3.40	1.52
1.30	-1.80	2.00	-0.69	2.70	0.41	3.45	1.60
1.35	-1.72	2.05	-0.62	2.75	0.49	3.50	1.67
1.40	-1.64	2.10	-0.54	2.80	0.57	3.55	1.75
1.45	-1.56	2.15	-0.46	2.85	0.65	3.60	1.83
1.50	-1.48	2.20	-0.38	2.95	0.81	3.65	1.91
1.55	-1.41	2.25	-0.30	3.00	0.88	3.70	1.99
1.60	-1.33	2.30	-0.22	3.05	0.96	3.75	2.07
1.65	-1.25	2.35	-0.14	3.10	1.04	3.80	2.15
1.70	-1.17	2.40	-0.06	3.15	1.12	3.85	2.23
1.75	-1.09	2.45	0.02	3.20	1.20	4.05	2.54
1.80	-1.01	2.50	0.10	3.25	1.28	4.20	2.78
1.85	-0.93	2.55	0.17	3.30	1.36		
1.90	-0.85	2.60	0.25	3.35	1.44		

Table 15. The respective z-score of Final Score with respect to its raw score (in points) of4- 5years age group for Floor Exercise MEAN=9.09S.D.=±3.09

Raw Score	z score	Raw Score	z score	Raw Score	z score	Raw Score	z score	Raw Score	z core	Raw Score	z core
1.65	-2.41	5.75	-1.08	7.10	-0.64	8.70	-0.13	10.50	0.44	12.90	1.23
2.00	-2.29	5.80	-1.06	7.15	-0.63	8.80	-0.09	10.60	0.47	12.95	1.25
2.10	-2.26	5.85	-1.05	7.20	-0.61	8.90	-0.06	10.65	0.49	13.00	1.26
2.20	-2.23	5.90	-1.03	7.25	-0.60	8.95	-0.05	10.70	0.52	13.05	1.28
2.35	-2.18	5.95	-1.02	7.30	-0.58	9.00	-0.03	10.80	0.55	13.10	1.30
3.80	-1.71	6.00	-1.00	7.35	-0.56	9.05	-0.01	10.90	0.59	13.15	1.31
4.40	-1.52	6.05	-0.98	7.40	-0.55	9.15	0.02	11.00	0.6	13.20	1.33
4.50	-1.48	6.10	-0.97	7.45	-0.53	9.20	0.04	11.10	0.65	13.25	1.35
4.65	-1.44	6.15	-0.95	7.50	-0.51	9.25	0.05	11.20	0.67	13.30	1.36
4.70	-1.42	6.25	-0.92	7.55	-0.50	9.40	0.10	11.30	0.71	13.40	1.38
4.75	-1.40	6.30	-0.90	7.60	-0.48	9.45	0.12	11.45	0.76	13.50	1.41
4.85	-1.37	6.35	-0.89	7.65	-0.47	9.50	0.13	11.60	0.81	13.60	1.44
5.05	-1.31	6.45	-0.85	7.70	-0.45	9.60	0.16	11.70	0.84	13.70	1.47
5.10	-1.29	6.50	-0.84	7.75	-0.43	9.65	0.18	11.85	0.89	13.80	1.52
5.15	-1.27	6.60	-0.81	7.80	-0.42	9.75	0.21	12.10	0.97	13.90	1.54
5.25	-1.24	6.65	-0.79	7.85	-0.40	9.80	0.23	12.15	0.99	14.00	1.59
5.30	-1.23	6.70	-0.77	7.90	-0.39	9.85	0.25	12.20	1.01	14.10	1.60
5.35	-1.21	6.75	-0.76	7.95	-0.37	9.90	0.26	12.25	1.02	14.20	1.64
5.40	-1.19	6.80	-0.74	8.05	-0.34	9.95	0.28	12.30	1.04	14.30	1.69
5.50	-1.16	6.85	-0.72	8.20	-0.29	10.00	0.29	12.35	1.05	14.60	1.77
5.55	-1.15	6.90	-0.71	8.25	-0.27	10.10	0.31	12.40	1.07	14.70	1.81
5.60	-1.13	6.95	-0.69	8.45	-0.21	10.20	0.34	12.55	1.12	15.60	2.09
5.65	-1.11	7.00	-0.68	8.60	-0.16	10.30	0.39	12.70	1.17	15.70	2.12
5.70	-1.10	7.05	-0.66	8.65	-0.14	10.40	0.41	12.85	1.22	16.80	2.48

Table 16. The norms for Floor Exercise of 4- 5years children, out of 20 points designed from the z-scores of Final Scores of Table No.15 as following

EVENT Floor Exercise	CATEGORY	RANGE OF POINTS
	Very Good	> 14.65
	Good	10.94 – 14.64
	Average	7.24 – 10.93
	Below Average	3.53 – 7.23
	Poor	< 3.53

Gymnast achieving *more than 14.65 points* out of 20 points, his/her performance was considered as *'Very Good'*. Similarly, gymnast who achieved *within 10.94 to 14.64 points*, his/her performance was considered as *'Good'*, gymnast who achieved *within 7.24 to 10.93 points*, his/her performance was considered as *'Average'*, gymnast who achieved *within 3.53 to 7.23* points, his/her performance was considered as *'Below Average'* and gymnast who achieved *less than 3.53 points*, his/her performance was considered as *'Poor'*.

CONCLUSION

The z-scores of the Final Score on the Floor Exercise apparatus were computed in Z-scale and categorically segregated into 5 categories, such as, Very Good, Good, Average, Below Average and Poor, respectively. There is considerable significance in systematically observing the comprehensive, targeted, and certain indicators of physical fitness during the gymnastics training process (Halilaj, Besim & Madić, Dejan & Sporis, Goran., 2018). Finally, and most importantly, there is a strong relationship between skill and fitness (Webster, *et al*., 2014), and between motor abilities and development of gymnastics skills (Pehkonen, M., 2010). Zivcic-Markovic, Sporis, and Cavar (2011) inferred that there is an alarming low level of the prior knowledge of gymnastics, which command the views regarding its application with primary and secondary school children. Moreover, an essential fact that affect the importance of gymnastics in the curriculum is that it is especially suitable for the adoption of basic movement structures that are preserved in the motor base in the form of motor fundamentals required for productive movement and their application in day-to-day life. The basic skills or parameters considered for the designing of the norms for the 4-5 years age category gymnasts of West Bengal definitely provide a wider base of knowledge for trainers to lay-out proper training schedule and dispense scope for progressive assessment of performance of the gymnasts that will provide valuable feedback to potentially improve the child's score, guide them to success and increase their confidence.

Each skill considered as parameter in this study should have a definite contribution in positive transfer of learning of sophisticated and higher degree of difficulty or elements in Gymnastics as well as in any other sport. The wide diversity of movements and positions makes it viable for children to develop a fund of quality sensory and motor pathways and make a positive stimulant on their psychosomatic status(Das Sengupta, D. & Paul, A., 2020). Motor learning requires to be recognized as a method of gradual skills acquisition. This process first starts with mistakes, graceless and slow attempts, over basic pattern acquisition, to higher-level performance of skills in different situations. However, basic skills should be mastered in young age or else progression of motor activities throughout life may get disturbed.

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