Correlation between anthropometric measurements and The Functional Reach Test (FRT) in 5- to 10-year-old typically developed Keralite children

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Abstract

Background: As the basis for all learning, mobility is a crucial component of a child's development, and balance refers to the capacity to maintain a controlled body position while performing a job. We can record the dynamic balance of the environment in the paediatric population thanks to the functional reach value. In order to understand the mechanism of postural control, the functional reach test has been proposed as a discrimination list and potentially as a diagnostic test. The goal of this study is to establish the functional reach test's normal values among 5 to 10-year-old typically developing children, evaluate the functional reach values between boys and girls of the same age group and determine the correlation between anthropometric parameters. Method: A total of 97 kids, ages 5 to 10, without disabilities were chosen at random, including 48 females and 49 boys. By paying attention to the arm's starting and ending positions, functional reach was measured. The mean of the three FRT trials was calculated after three consecutive trials had been completed. To investigate the relationship between FRT and anthropometric measurements, the Pearson correlation was used. Results: Functional reach norms for boys and girls were 22.3 ± 5.1 and 22.3 ± 4.4 respectively. For both boys and girls, there was no discernible correlation between anthropometric measurements and functional reach values. Findings also showed that age, height, weight, and the length of the right upper extremity were important determinants impacting FRT levels in both girls and boys. Conclusion: The age, height, weight, and length of the right upper extremity were significant factors influencing FRT levels in both girls and boys. Although girls are more flexible than boys, this study found no difference between boys and girls that could be considered statistically significant. To evaluate children's dynamic and static balancing skills, the FRT can be combined with additional tests.

Keywords: *Functional Reach Test, Anthropometric measures, 5- to 10-year-old children*

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1. INTRODUCTION

An infant initially learns to control their head, then their trunk, and finally their posture.[1] The ability to maintain a generally stable position of the body in a variety of postures while performing a variety of movements or actions while subject to external pressures is known as balance. To manage the position of the body in space, postural control is the capacity to govern the body's centre of mass in relation to the base of support with the least amount of sway.[2]

The Children's balance is crucial for various activities, such as playing, walking, reaching, and running in a variety of settings, including school, home, and the community.[3] Children's balance gets better with age, enabling them to handle daily tasks on their own.[4] A child who struggles with postural stability is more reliant on a caregiver, and as they get older, the problem could severely limit their capacity to participate in community activities.[5]

Children of different ages, with and without disabilities, are tested in different ways to assess static and dynamic balance. Some of these examinations are intended to assess balance particularly.[6]The Functional Reach Test is one of the most popular (FRT)

The FRT assesses the forward stability of a standing individual who extends one arm as far forward as they are able to in the horizontal plane while maintaining both heels on the ground. The score is calculated by measuring the distance between the starting and ending positions of the fingertip. Flexion of the leg, hip, and trunk joints is required to complete the FRT. Therefore, a variety of strategies can be employed to obtain the same FRT score.[7] Numerous studies have shown the FRT to be very reliable and to have little inter-examiner variability. The FRT score and the anteroposterior excursion of the centre of pressure (CoP) are correlated The FRT is also sensitive to change and it has good repeatability across time.[8]

A reliability study and a descriptive study were conducted on 116 kids between the ages of 5 and 15 by Donohoe et al. Data was gathered by two qualified paediatric physical therapists. There were five age categories, each divided into two years, with group sizes ranging from 10 (13 to 15 years old) to 36 (over 16 years old) (7– 8 years old).

According to the researchers, every subject was able to complete the FRT satisfactorily.[9] The Paediatric Reach Test was created by Bartlett et al. for children between the ages of 2.6 and 14.1 who have been diagnosed with cerebral palsy as well as children between the ages of 3 and 12.5 who are developing normally. In this study, researchers looked at the validity and dependability of balancing tests performed while standing and sitting.[9] Researchers contrasted reaching data with stability limit data obtained using a force platform. The Pediatric Reach Test's standing forward test is similar to the FRT, despite the fact that Bartlett et al.did not compare their results with the FRT. As a result of their research, they came to the overall conclusion that the Pediatric Reach Test is a "simple, valid, and reliable test that can be employed with children. [10]

In Kerala, the physical, monetary, and social surroundings in which youngsters sit or move around in the course of their everyday lives have been changing quickly over time. The demands for physical activity have been greatly lowered as a result of these improvements in transportation, communications, employment, and home entertainment technology. Balance issues are one class of health-related behaviours that are connected with these decreases in the environmental demands for physical activity. Therefore, the objectives of this study were to establish normative values and variability of FRT scores and to investigate the impact of age and anthropometric measurements on FRT scores in Keralite children aged 5 to 10 without disabilities.

2. METHODS

2.1 Subjects

A stratified sampling strategy was used to conduct this correlation analysis. Ages 5 to 10 were chosen, and the students were from reputable schools. Right-handedness, normal proprioception, normal coordination, and normal upper and lower limbs were the inclusion criteria. If a parent or legal guardian disclosed that their child (1) had a history of any previous ankle, knee, or hip injuries that required medical attention, (2) had a history of any neurological issues, (3) had visual disorders, and (4) had recent ear infections, the child was disqualified from the study. The total number of subjects increased to 97 after the youngsters who failed to meet the inclusion requirements were excluded. Researchers and the school health unit issued private letters outlining the study's objectives and requesting approval from the parents of the study sample. Subjects were divided into 5 subgroups depending on age, that is, 5, 6, 7, 8, 9 and 10 years. Children between the ages of 5 and 1 day before their next birthday were included in the 5-year-old group of subjects, and the remaining subjects were separated into age-related groups as well.

2.2 Materials

A meter stick to measure the FR distance, a bubble level to make sure the meter stick was level, a calibrated scale to measure body weight, and a stadiometer to measure standing height were the materials utilized in this experiment. At each site where data was collected, the same equipment was used.

2.3 Procedure

The target population was represented in the classes that were chosen by lottery. On the basis of inclusion and exclusion criteria, the subjects were chosen.

Age, height, and weight information were gathered. Using a stadiometer, height was calculated to the closest 0.5 cm. Height is the greatest distance, measured with the participant gazing straight ahead, between the floor and the highest point of the head. The participants were instructed to stand straight, flat on the floor with their feet together and their backs, buttocks, and heels against the stadiometer. The participants were instructed to inhale deeply and hold it while gazing straight ahead. At the end of each participant's deep inhalation, height was measured.

Standing with the elbow extended, the forearm pronated, the wrist neutral, and the fingers extended, the upper extremity length was measured in centimetres from the tip of the acromion process to the tip of the middle finger.

The digital weight scale was used to record the user's weight. Participants were instructed to stand unaided in the centre of the scale with their weight evenly spread across both feet, and the weight was then recorded.

2.4 Protocol for functional reach testing

First, the child’s shoes and socks were taken off; next, a piece of masking tape was laid down on the ground parallel to the wall, and everyone was told to line up their toes behind the tape. The levelled metre stick was placed at the height of each subject's acromion process on a wall that the subjects faced perpendicularly.

The third metacarpal was placed along the meterstick to take the initial measurement of the FR distance with the child's arm lifted horizontally (around 90° of shoulder flexion). After arriving, a second measurement was taken, this time utilizing the third metacarpal's position along the meter stick. The child's standing distance was the variable that was measured.

If the FR was completed without the kid stepping, touching the wall, or requesting assistance from the researcher, the trial was considered successful.

Each youngster was permitted to complete three recorded trials, from which the mean was computed. One minute-long, brief rest breaks were permitted. The verbal instructions and demonstrations given to each individual were the same.

2.5 Data Analysis

Utilizing SPSS for Windows, data analysis was carried out. For all age groups, descriptive data were obtained for the FRT's normal values. The Kolmogorov-Smirnov test was performed to determine whether the data was normal. When examining correlations between age, gender, height, weight, BMI, and the length of the right upper extremity, a non-parametric test is used: the Pearson correlation coefficient.

3. RESULTS

Table-1: Participants' anthropometric data

Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)	Length of UE (cm)
5	106.6 ± 0.6	17.2 ± 0.7	15.1± 0.6	15.1 ± 1.6
6	110.2 ± 4.3	18.7 ± 1.6	15.4 ± 1.4	47.9 ± 1.9
7	118.1 ± 4.8	20.7 ± 1.6	14.9 ± 1.4	50.2 ± 1.2
8	128.9 ± 6.8	27.2 ± 6.5	16.3 ± 3.3	53.9 ± 3.6

9	132.8 ± 7.1	31.1 ± 8.6	17.5 ± 4.4	55.6 ± 3.3
10	137 ± 6.4	31.9 ± 7.3	17.2 ± 4.5	59.6 ± 3.8

Table 1 displays the anthropometric measurements of the study participants.

Table- 2: Anthropometric measurements of participants in relation to gender

Gender	N	Age	Height	Weight	BMI	Length of UE
Boys	49	7.7±1.3	126±11.5	26.5±7.6	16.4±2.8	53.2±4.7
Girls	48	7.8±1.6	123.7±11.5	24.5±7.8	15.9±3.7	52.5±3.7

Table 2 shows the anthropometric measurements of participants in relation to gender. Out of 97 selected participants, 49 were boys and 48 were girls.

Table -3: Normal values of Functional reach test

Characteristics	Value
FRT score	22.3 ± 4.8

Table 3 displays the normalcy value for FRT scores in normally developing children aged 5 to 10.

Table -4: Normal values of Functional reach test scores in boys and girls

Characteristics	Boys	Girls	P value
FRT score	22.3 ± 5.1	22.3 ± 4.4	0.15

The normality values for male and female FRT scores are displayed in Table 4. When significance is determined by a p-value < 0.05, there is no difference between males and females.

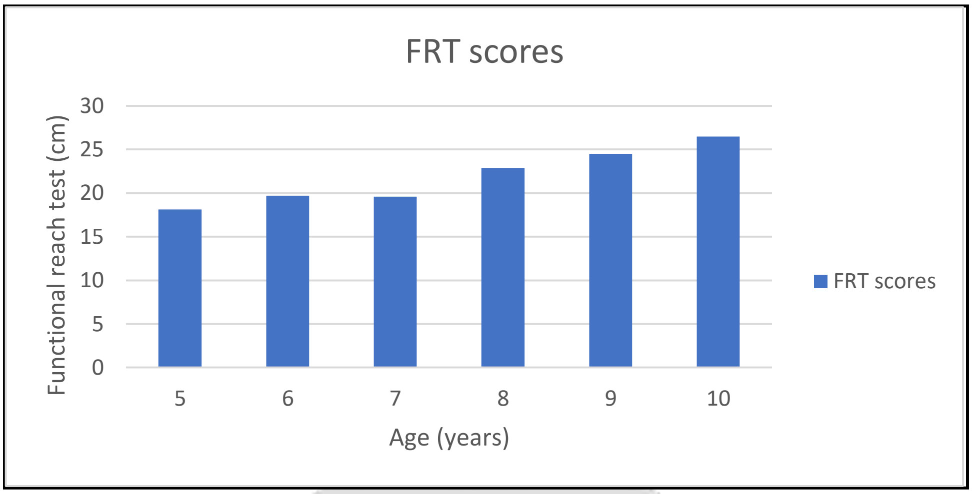

Figure- 1: Age-related comparison of the mean FRT distance values

The average FRT distance values are shown by age in Figure 1. From 8 to 10 years of age, there was a rise in FR distance. Age 6 and 7 values were remarkably similar.

Table 5: The correlation between FRT scores and anthropometric parameters

Sex	N	FRT Mean±SD	Age (years)		Height (cm)		Weight (kg)		BMI (kg/m^2)		Length of Right UE	
			r	p	r	p	r	p	r	p	r	p
Boys	49	22.3±5.2	0.52	0.0081**	0.60	0.00001**	0.51	0.000188**	0.22	0.13	0.62	0.00001**
Girls	48	22.3±4.4	0.54	0.000053**	0.52	0.000124**	0.53	0.000108**	0.31	0.029*	0.53	0.000081**

*: significant **: highly significant

The means and standard deviations of the FRT scores, as well as their correlations with anthropometric factors, are displayed in Table 5. In terms of anthropometrics, there is a highly substantial association between boys and girls in terms of age, weight, height, and right upper extremity length. The FR distance for BMI only significantly correlated with girls.

4. DISCUSSION

Kerala has experienced incredible progress in recent years at an incredible rate. As living standards grow, mechanisation has become more and more pervasive in all facets of people's lives. There will probably be a variety of changes in physical activity as industrialization and modernization advance. In fact, sedentary lifestyles and lack of physical activity are on the rise, along with the related poor levels of fitness. The future is expected to see a greater decline in physical activity due to the rising use of computer and telecommunications technology, satellite television, and other factors. These lifestyle changes have a significant negative impact on the general health of society. One of the frequent risk factors for falling is a lack of exercise.[11,12,13]

Evaluation of the body's balance is crucial, particularly when it relates to enhancing a person's daily activities. The shorter the consequences of therapeutic intervention can be for a balance deficit, avoiding, among other things, problems with learning and sociability. Children with an immature balance function are more likely to have learning challenges that interfere with their schoolwork. The balance is a crucial evolutionary function that ultimately serves as a gauge of brain maturation.[14]

Our study's findings showed that the typical mean FRT values ranged from 17.2 cm to 31.7 cm. In research by Donahoe et al. on a comparable age group in the United States, the FRT values ranged from 21.8 cm to 32.8 cm.[9]

Our findings showed that functional reach test scores often increase with age, notably between the ages of 8 and 10. This supports Shumway's assertion that standing balance control in children differs from standing balance control in adults as judged by sway performance. Children's bodies are top-heavier than adults' bodies, which causes a slightly higher centre of mass position in children. The outcome is differing sway performances in younger children (below the age of 10) and adults, in terms of both amplitude and velocity of sway, together with the fact that children's motions have not yet fully matured.[15]

The current study's findings also revealed that age, height, weight, and the length of the right upper extremity were significant factors influencing FRT levels in both girls and boys. Our findings are consistent with those of other researchers who found a strong relationship between FRT scores in children with typical development and subject characteristics like age and height.

5.1 Limitations and scope of the study

Only a small number of people took part in this study. Future research needs to include more individuals. Children who took part in the study resided in a limited local region, thus it's possible that the usual FRT values found in the current study can't be applied to all Keralite children. Another drawback is that a thorough medical history was not gathered.

Future research might compare the FRT scores to additional anthropometric measurements including lower extremity and trunk length and base of support.

6. CONCLUSION

In both girls and boys, FRT levels were significantly influenced by age, height, weight, and the length of the right upper extremity. Despite the fact that girls are more flexible than boys, this study did not uncover any statistically significant differences between boys and girls. The FRT can be used in conjunction with additional tests to assess children's abilities in both dynamic and static balancing.

7. ACKNOWLEDGEMENTS

We appreciate the trust and cooperation of all the kids, parents, and teachers in this study.

8. DECLARATIONS

No funding sources and no conflict of interest

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