Reference values of Functional Reach Test in Gujarati Population

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Abstract: Background & Objectives: Functional reach test is used to assess dynamic balance in individuals. The objective of the study is to estimate the reference values for functional reach test in Gujarati population. Methods: Observational; cross sectional study design was conducted on 843 normal healthy individuals with age group 18-60 years. Functional reach measured with subject standing next to the wall (without touching it), with shoulder flexed to 90°, elbow fully extended with hand full fist. Initial marking is made at the position of 3rd metacarpal along the yardstick on the wall. Subject is then instructed to lean as far forward as possible without taking a step or losing balance. Second marking is then made again using 3rd metacarpal as reference along the yardstick on the wall. The difference between two markings is the forward reach distance used for functional reach test. Results: Reference range for males is 9 – 19 inches and females is 7 – 17 inches. Negative correlation (ρ = -0.25) between functional reach and age whereas a positive correlation (ρ = 0.47) between functional reach and height. Interpretation & Conclusion: Norms for functional reach test has been established for Gujarati population. Age and Height are the contributory factors affecting functional reach. [Rathod S Natl J Integr Res Med, 2019; 10(1):21-24]

Key Words: Balance performance, Functional Reach test, Reference values

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Introduction: Balance is the condition in which all the forces acting on the body are balanced such that the centre of mass is within stability limits, boundaries of base of support[1]. Functional tests for balance focus on static balance, dynamic balance, response to perturbations and functional mobility. Various functional balance tests are Beg balance scale, Tinetti Performance oriented mobility assessment, timed up and go test, timed walking test, Functional reach test and Multidirectional reach test. Functional reach test was developed by Duncan and co-workers to screen out person with balance problems. It is simple, valid, reliable, easy to administer and clinically accessible[2]. It is maximal distance one can reach forward beyond arm's length while maintaining a fixed base of support in standing position. Reference values by age have been provided by them according to gender. Functional reach is affected by age and height. It provides baseline and outcome data, also it is predictive of falls in elderly individuals[2]. For western populations, normative values are available for functional reach test in children, adults and elderly[3-5]. Limited studies are available for normative values in Indian population[6-8].

A study was conducted on 135 healthy subjects to establish the norms of Functional Reach Test (FRT) values among different ethnicity (Malay, Chinese and Indian) from the age of 20 to 87 years and to compare mean of FRT between ethnicity. The results showed that mean (SD) for forward distance for Indian male was 35.70(5.15) cm and Indian female was 27.82(9.25) cm[6].

350 children were enrolled to establish normal values for functional reach (FR) and lateral reach (LR) in school children and to correlate anthropometric measures with FR and LR values and the association between FR and LR scores. Results showed normal mean values of FR and LR range from 22.7 cm to 37 cm and 16.3 cm to 22.5 cm, respectively. Height significantly correlates with both FR and LR[7].

202 children were enrolled for the study to estimate the normative values for age group of 5-15 years in Indian population. They concluded that age and height are main predictors of mean reach[8].

At present in clinical practice normative reference data for functional reach test is used but those are considered based on western population. However in Gujarat, reference values are not available for functional reach test. So there is a need to establish reference values for functional reach test in Gujarati population. The objective of the study is to estimate the reference values for functional reach test in Gujarati population.

Materials and Methods: Ethical approval for the study was taken from M P Shah medical college, Institutional Ethical Committee, Jamnagar, Gujarat, India. Observational; cross-sectional study design was conducted on 843 normal healthy individuals with age group 18-60 years. Sample size was decided based on the guidelines of CLSI (Clinical and Laboratory Standards

Institute) for reference values. Subjects were called for the study through mouth to mouth publicity. Inclusion criteria were male and female subjects between 18-60 years of age, able to stand independently, having adequate shoulder range of motion and willing to participate. Subjects were excluded if they had any neurological conditions that could affect balance and falls such as CVA, Parkinson's disease, TIA, musculoskeletal conditions affecting upper limb and lower limbs, subjects undergoing balance training and strengthening exercise training for lower-limb and subjects using any assistive devices.

Random sampling was done. Every alternate subject who was willing to participate was enrolled. Then on the basis of inclusion and exclusion criteria final subjects participated in the study. Each subject filled out the Subject Information sheet and signed informed consent form (in vernacular language if needed). Demographic data such as age, gender, weight and height was taken of the subject. Weight was measured on standard weighing scale (OMRON – HN286). Height was measured with stadiometer (Krups). Double Blinding was done in the study. Materials used were yardstick, measure tape, chalk stick (Color), Weighing scale, Stadiometer.

Procedure: Familiarization with the technique of test performance was done by demonstration of the test. Subject stands next to the wall (without touching it), feet normal stance width with weight equally distributed on both the feet. Shoes or socks were not worn during the test. Identical foot placement was maintained throughout by marking a line on the floor. Yardstick was mounted on the wall at the height of subject's acromion process. Shoulder was flexed to 90°, elbow fully extended with hand full fist. Initial marking was made at the position of 3rd metacarpal along the yardstick on the wall. Subject was then instructed to lean as far forward as possible without taking a step or losing balance. Second marking was then made again using 3rd metacarpal as reference along the yardstick on the wall. The difference between two markings is the forward reach distance used for functional reach test[1]. Three recordings were taken with sufficient rest period between them. Best of three will be used for final analysis.

Statistical analysis: Data was entered and analyzed in Medcalc statistical software. Reference ranges for Functional reach test are calculated using mean, Standard Deviation, median and Interquartile Range. Reference ranges were calculated using Medcalc statistical software with 90% confidence interval. For the purpose of analysis subjects were divided in group A, group B, group C and group D on the basis of age group. Group A: 18 – 30 years, Group B: 31 – 40 years, Group C: 41 – 50 years and Group D: 51-60 years. Correlations were tested by Spearman's correlation coefficient. Level of significance kept at 0.05.

Results : Result are displayed in table 1 to 4.

Table 1: Demographic characteristics of subjects

Gender	Age (years)	Height (meters)	Weight (Kg.)	BMI (Kg/mt^2)
Male (n=560)	28.61 (10.57)	1.71 (0.05)	65.80 (9.38)	22.53 (3.16)
Female (n=283)	41.67 (10.62)	1.55 (0.05)	64.99 (11.59)	27.01 (4.61)
Total (n=843)	32.99 (12.25)	1.66 (0.09)	65.53 (10.18)	24.04 (4.27)

Data is mentioned in Mean (SD); BMI – Body Mass Index

Table 2: Reference values for functional reach on basis of gender

Gender	Mean (SD)	25th Percentile	Median (50th Percentile)	75th Percentile	IQR	Lower limit		Upper limit		Reference values
						Value	90% CI	Value	90% CI	
Male	13.87(2.56)	12	14	16	4	9	8.5-9	19	18.5-20	9-19
Female	11.70(2.50)	10	11.50	13	3	7	6-7.5	17	16-18	7-17
Total	13.14(2.74)	11	13	15	4	8	7.5-8.5	19	18-19	8-19

Values are mentioned in inches; SD – Standard Deviation; IQR – Interquartile range; CI – Confidence Interval

Discussion : The present study was conducted to estimate the reference values of functional reach test in Gujarati population in 843 individuals between the age group of 18 – 60 years. Results of the present study show reference range for males is 9 – 19 inches and females is 7 – 17 inches. Difference in the range of male and female can be attributed to the

difference in mean age and mean height of males and females in our study. As age and height are factors affecting distance reached in forward direction. Our findings also concluded that there is negative correlation (ρ = -0.25) between functional reach and age whereas a positive correlation (ρ = 0.47) between functional reach and height. Findings are consistent with Jayachandran et al who found negative correlation with r=-0.41 between age and Functional Reach Test and positive correlation with r=0.49 between height and Functional Reach Test[6]; Srikanth et al stated strong negative correlation between age and forward reach and strong positive correlation between height and forward reach among 360 Indians above 21 years of age[9].

Table 3: Reference values for functional reach on basis of age group

Group	Mean (SD)	25th Percentile	Median (50th Percentile)	75th Percentile	IQR	Lower limit		Upper limit		Reference values
						Value	90% CI	Value	90% CI	
Group A (n=459)	13.81(2.64)	12	14	16	4	9	8.5-9.5	19	18.5-20.5	9-19
Group B (n=132)	12.59(2.56)	11	12.75	14	3	7	6-9	19	16-20	7-19
Group C (n=138)	12.09(2.46)	10	12	14	4	7.5	6-8	17	16-18	7.5-17
Group D (n=114)	12.35(2.93)	10	12.5	15	5	6.5	6-7	18	17-18	6.5-18

Values are mentioned in inches; SD – Standard Deviation; IQR – Interquartile range; CI – Confidence Interval; Group A: 18 – 30 years, Group B: 31 – 40 years, Group C: 41 – 50 years and Group D: 51-60 years

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Table 4: Correlations between functional reach with other variables

Variable	Spearman's correlation coefficient (ρ)
Age	-0.25*
Height	0.47*
Weight	0.12*
BMI	-0.20*

*P Value < 0.01

Available literature states height and age to be major contributing factor for difference in functional reach[3,7,8,10]. Functional reach test is based on postural control theory. Volitional arm movements are coupled with stabilizing postural activity of the leg and trunk muscles[3]. Elderly individuals has decreased efficiency of movement, delayed anticipatory preparation for movement, and impaired coordination of postural adjustments for upper extremity movement compared with young controls[3].

We also found that as age increases the reference range of functional reach test decreases. Deterioration in functional reach with advancing age may be a protective mechanism to prevent fall by reducing disturbance in centre of gravity[3]. Normal values given by Duncan et al differs from our finding, they found mean functional reach in age group of 20 – 40 years to be 16.73 inches in males and 14.64 inches in females whereas in group of 41 - 69 years they found it to be 14.98 inches in males and 13.81 inches in females[3].

These differences in functional reach between our study and study by Duncan et al can be due to anthropometrical differences between the 2 samples. Also our findings for Group D are similar to Sadashiv et al who found mean forward reach to be 35.06 cm in individuals of 50-60 age group[10]. We found lower values compared to values found by Isles et al who stated mean functional reach to be 42.71 cm, 41.01 cm, 40.37 cm, 38.08 cm, 36.85 cm and 34.13 cm in 20-29 age group, 30-39 age group, 40-49 age group, 50-59 age group, 60-69 age group and 70-79 age group respectively[4]. It could be justified as subjects enrolled for their study were only females from the region of Australia, whereas we enrolled subjects of both gender from Gujarati (Indian) population. This suggests anthropometrical difference between the study samples. Plantar flexor muscle torque may have affected the performance in older age because it is thought to affect ankle strategy which is required during functional reach test but in our study we have not measured muscle torque.

Limitation of our study is equal number of subjects from both the gender did not participated in the study. This could be the reason for difference in functional reach in both genders.

Conclusion : Norms for functional reach test has been established for Gujarati population. Age and Height are the contributory factors affecting functional reach.

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