

Norms Of Prone Plank Testing For Isometric Endurance Assessment In Indian Healthy College Aged Individuals - An Observational Cross Sectional Study

Dr. Yashshree Pandit*, Dr. Richa Bisen**, Dr. Khyati Kalra***

*PT, B. P.Th, **PT, MPT In Orthopaedics And Manual Therapy, Assistant Professor Electrotherapy And Electro Diagnosis Department, ***Assistant Professor Cum Statistician, Department Of Community Medicine, Smt. Kashibai Navale Medical College And General Hospital, Pune - 411041

Abstract: Background: Assessment of Musculoskeletal performance is crucial to analyze for development and improvement of required goals and reducing risk of injuries. Isometric endurance assessment of core, as a part of this analysis is often done with techniques that are valid. Objective: To develop normative percentile separated by gender of hold time of prone plank in Indian college aged individuals, investigate effect of habitual physical activity along with reason for test termination and effect of BMI with hold time of testing. Material And Methods: 206 individuals meeting the inclusion criteria performed the prone plank test as long as they can and time was noted. Result: Males produced significantly longer test duration than females and BMI is inversely proportional to hold time. Conclusion: These normative percentiles for abdominal endurance suggest that the abdominal plank test can now be used as an alternative to other abdominal assessments in Indian college students. [Pandit Y Natl J Integr Res Med, 2021; 12(4): 51-55]

Key Words: College-Aged Individuals, Isometric Endurance Testing, Prone Plank Test

Author for correspondence: Dr. Yashshree Pandit, PT, Smt. Kashibai Navale Medical College And General Hospital, Pune - 411041 E-Mail: pandityashshree1798@gmail.com

Introduction: The abdominal core muscles play an important role in body stabilization during force generation involved in various activities. Core stability is defined as the ability to control the position and motion of the trunk over the pelvis to allow optimum production, transfer and control of force and motion of the terminal segment¹.

Core muscles are deep and shallow muscles of trunk they stabilize spinal column, align body weight and enhance performance when extremities move². The core is described as a muscular box with the abdominals in front, paraspinals and gluteals in the rear, the diaphragm at the top, and pelvic floor and the hip girdle musculature at the bottom³.

Particular attention has been paid to the core because it serves as a muscular corset that works as a unit to stabilize the body and spine, with and without limb movement, improving balance and postural control, it serves as the centre of the functional kinetic chain, reduce risk of injuries, musculoskeletal and back disorders⁴.

The two common categories of muscular assessment include strength and endurance testing. Muscular endurance is defined as the ability to sustain a given level of force production over time. While muscular strength is defined as

maximum torque exerted by a muscle or muscle group. Moreover, previous research has suggested that muscular endurance is functionally more important to the supportive musculature of the core than muscular strength⁵.

Of the different available assessment strategies, isometric endurance testing seems to be cost effective, easy and quick to perform and requires no special equipment^{6,7}. Commonly used tests for assessing core muscle function include the sit up test, the side bridge test, the supine bridge test, the prone plank test, the Biering-Sorensen test, the v-sit flexor endurance test etc^{8,9}. other like straight leg and bent-leg sit up protocols have high muscle challenge using rectus abdominis, but also puts a high compression force on L4 and L5 vertebrae and hence not safe to train the movement system of core⁹.

The Prone plank test has been theorized to be more functional because it provides for assessment of endurance during an activity requiring simultaneous activation of the entire anterior muscular chain¹⁰.

EMG analysis done in University of Dakota identified muscle activation in prone plank appears to engage external oblique, rectus abdominis, and internal oblique are enough for endurance training. However, gluteus medius is

This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), allowing third parties to copy and redistribute the material in any medium or format and to remix, transform, and build upon the material for any purpose, even commercially, provided the original work is properly cited and states its license.

only lightly activated during prone plank¹¹. Test retest reliability for continuous prone plank test was measured at 0.78¹². A previous study done on Indian students gave hold time of prone plank for individuals with back-pain and without back-pain. Results showed higher holding time in subjects without low back pain, in boys of both groups and in active subjects¹³.

Therefore, the purpose of this study was to describe the prone plank test as an alternative assessment of muscular trunk endurance through the creation of percentiles for the purpose of ranking college-aged Indian participants in the establishment of data norms separated by sex.

We proposed to accomplish this through a test that was less complicated to administer, as well as to increase the construct validity of assessing abdominal endurance, and lessen the risk of lower-back injury.

Material & Methods: An observational cross-sectional study was done in Pune city in time span of 6 months, 206 individuals were selected of which 86 were males and 120 were females.

Inclusion Criteria: Age group 18-25 years, Male and female.

Exclusion Criteria: Undergoing orthopaedic surgery, spine related problem. Any Musculoskeletal disorder like recent fracture, joint instability. Any neuromuscular disorder like traumatic brain injury, CV stroke, Vestibular disorders. If they could not perform the exercise. Individuals not able to understand commands.

Study Materials: Yoga mat, Stopwatch, Weighing machine, Measuring tape, Pen, Paper.

Procedure: Ethical clearance was obtained from institutional review board. All the subjects meeting inclusion criteria took part in this study.

Informed and written consent was taken from subjects after explaining purpose of study.

Participant's descriptive data and anthropometrics like height, weight and level of physical activity/week was taken.

Following a brief technique of demonstration and detailed instruction, subjects were tested individually, Subject assumed test position with

elbows in contact with the ground such that humerus formed a perpendicular line to the horizontal plane, directly beneath the shoulders, the forearms in neutral position and hands directly in front of the elbows.

The participant assumes a rigid anatomical position so that only there forearm and toes supports the body. This position is characterised by phalangeal extension, neutral ankle, knee, hip extension and neutral spinal position.

The participants were instructed to statically hold this position as long as possible and verbal clues were provided to promote adherence. When subjects assumed proper position, stopwatch was started.

The test was terminated when, The participants fatigue or voluntarily stopped the test, The participants fails to maintain the proper position, The participants report ill effects from the test (headache, dizziness, pain not associated by fatigue etc-), The investigator noticed signs indicative of ill effects in the participant from the test.

Test was repeated for 3 times and best of 3 was selected.

At the conclusion of the test, the total duration of holding the test position was recorded for each participant and reason for rest termination was noted.

Due to COVID Pandemic situation few of the samples were observed through video conferencing and hold time was noted whereas others were taken in offline mode and universal precautions were maintained.

Statistical Analysis: Data analysis was done using SPSS (version15, Predictive Analytics Soft-Ware) and Medcalc software system. Non-parametric testing was done for males and females separately and Pearson coefficient was calculated. Separate Percentile rankings were generated with 95% confidence interval. Chi-square testing was done for reasons of test termination.

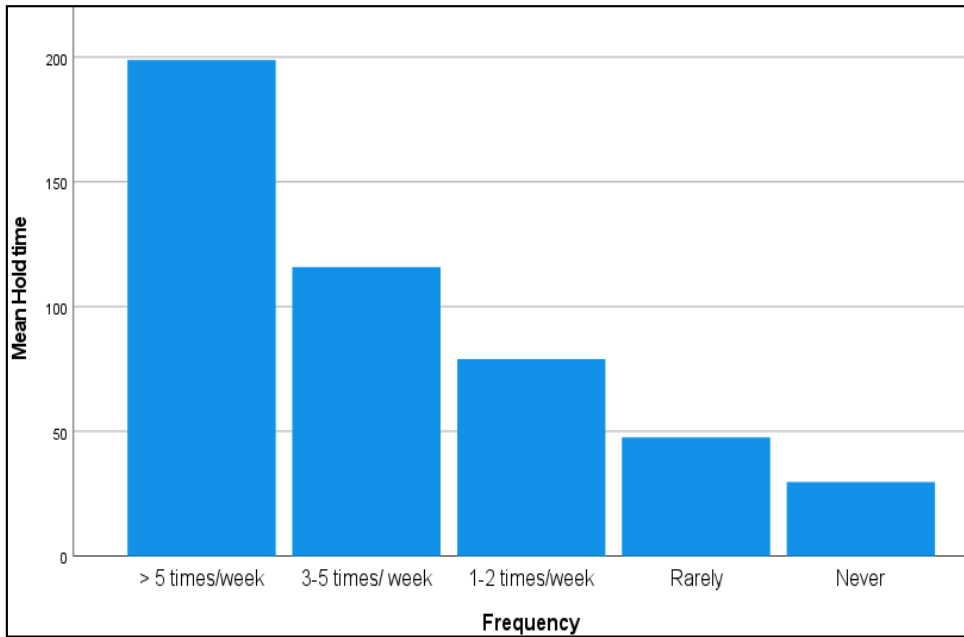
Results: Statistical significance was seen between both genders for hold time where Males were shown to have test duration 90% greater than females, as shown in Table 1.

Table 1: Hold Time For Prone Plank

Males	Females
97 ± 49 seconds	51±36 Seconds
P= 0.0240	P= <0.0001

Effect of activity pattern/week on test duration was seen previous to the testing sessions, as shown in graph 1.

Graph 1: Activity Levels Per Week Of All Participants



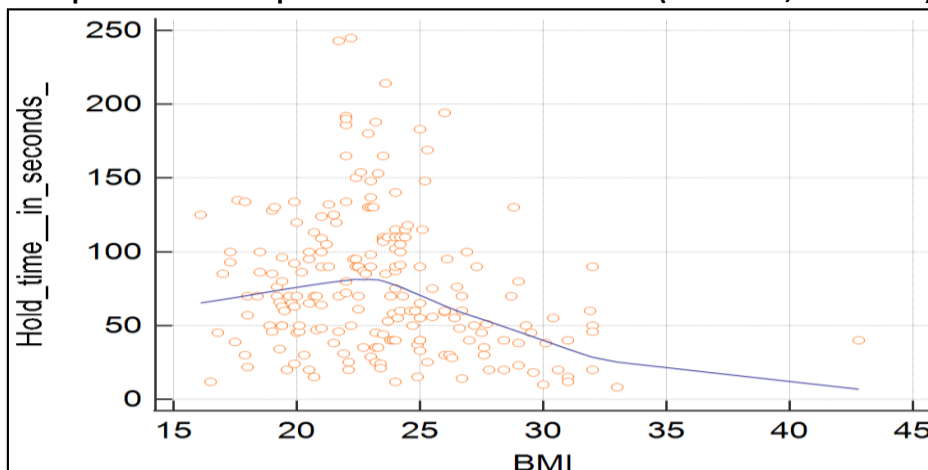
Reasons for test termination shown in table 2.

Table 2: Reasons For Test Termination Using Chi-Square Testing

Gender		Abdominals	Arms	Legs	Hands	Posture	Back Pain
Males	Frequency	30	28	24	0	3	1
	% In Sex	34.9	32.6	27.8	0	3.5	1.2
Females	Frequency	34	35	16	2	24	10
	% In Sex	28.1	28.9	13.2	1.7	19.8	8.3
Total	Frequency	64	63	40	2	27	11
	% For Population	31.5	30.7	20.5	1.0	11.6	4.7

Co-relational analysis investigating relationship between BMI and test duration, shown in Graph 2.

Graph 2: Relationship Between BMI And Hold Time (P= 0.0013, r= -0.2224)



Discussion: The primary purpose of this study was to develop a normative data for assessing abdominal endurance with a testing protocol advantageous to existing tests and that is clinically easy to perform on normal college aged Indian population.

In this study, 206 individuals were tested of which 42% (n=86) were males and 58% (n= 120) were females.

For this study as a measure of central tendency median was calculated for hold time since the data is not distributed in normal bell shaped curve. And hence different values for males and females were generated. In previous studies done on Indian population mean hold time for individuals with low-back pain was 33.93 ± 1.545 seconds and that without low back-pain was 51.03 ± 2.908 seconds.

This study involves use of prone plank as it is more accurate, valid and reliable for assessment of core musculature¹⁴. Also a hypothesis behind the practice of plank exercise states that it helps Strengthening of core muscles such as transverses abdominis, multifidus, diaphragm and pelvic floor muscles by effectively co-contracting these muscles in performing exercises¹⁵ and hence effectively used as a method for testing core endurance and can be used as treatment protocol for strengthening.

Also, testing with prone plank is much simpler to administer, as there are fewer directions and increased tester objectivity in the ability to define proper and improper technique. Also this test does not involve an external load (other than body weight), and involves only a static (isometric) position placing minimal compression on the spine when it is performed with neutral spine alignment¹¹. It is convenient for the patient and therapist both⁸.

In this study, Statistically, females demonstrate higher time to fatigue than males, hence separate percentile rankings were generated.

Males were found to have significantly longer test durations (90% greater than females) on the plank test than a corresponding group of females, supporting the previous researches where gender differences were seen with the plank position. Several factors may explain the poor core muscular endurance. First biomechanical

strategies required for muscular endurance test, Plank test depends upon gravity's action on body mass on entire load and ability to support body loads against gravity¹⁶. Other causes can be differences between physiology, morphology of core muscles, general fitness levels, perceived exertion levels on fitness exercises along with possible negative influence of other co-morbidities with obesity.

Examining the possibility of physical activity with the duration of hold time in this study differences were seen at all levels of physical activity, due to large variance in groups hence giving weak relationship but we found a significantly negative correlation between BMI and test duration hence supporting the possibility that BMI (height, weight), Gender are determining factors in predicting time for fatigue.

Also, as physical activity was not significantly related to test duration hence increase in muscular endurance suggest a threshold of activity is necessary to increase abdominal endurance where being active <3 times/week would not be expected to significantly increase fatigue onset. Thus suggesting for expected improvement to occur abdominal endurance at least 3 times/week would need to be prescribed and programmed over 5 days/week to produce most benefits for individuals.

Reason for test termination was found to be significantly related to test duration but no significant differences were seen between the sexes and fatigue of abs was common reason for test termination in both sexes. One explanation for this might be that if abdominals were undertrained, they would be weak link in abdominal plank and therefore produce discomfort and early fatigue. Notably, though participants who cited abdominal fatigue as a reason for test termination had low hold duration.

Thus giving a valuable diagnostic tool in determining priority where additional abdominal training might be prescribed to reduce chances of injuries, and hence clinically it can also be used as a tool to mark changes in abdominal endurance testing.

The investigation into anthropometrics was included in the hypothesis that higher body mass might produce a greater challenge to plank

success because greater torque would need to be generated and sustained over time in order to maintain static position. This was confirmed as differences were seen in this study in mean time to fatigue by individual sexes.

Limitations: Small sample size. Only college aged individuals involved. Athletic status not taken into consideration.

Conclusion: Average hold time for males is greater than that of females as 97 ± 49 seconds and 51 ± 36 Seconds respectively. BMI is inversely related to the hold time of prone plank.

Clinical Implication: Norms will help to test, compare, analyse and evaluate ones strength and weaknesses. It will also guide and direct Indian youth about their muscular endurance status and help therapists/ trainers to design training programme accordingly.

Future Scope Of The Study: Normative data for side planks can be calculated. Normative data in athletic and non athletic Indian population can be calculated.

References:

1. Kibler WB, Press J, Sciascia A. The Role of Core Stability in Athletic Function. Sports Medicine. 2006 ;36(3):189-198.
2. Key J. 'The Core': understanding it, and retraining its dysfunction. Journal of Body work and Movement Therapy. 2013 Oct; 17(4):541-59.
3. Akuthota V, Nadler S F. Core strengthening. Arch Phys Med Rehabilitation 2004; 85(1):S86-92.
4. Bliven H, Anderson B. Core Stability Training for Injury Prevention. Sports Health A Multidiscip.Approach 2013 Nov; 5(6):514–522.
5. Borghuis J, Hof AL, Lemmink KA. The importance of sensory-motor control in providing core stability: implications for measurement and training. Sports Med. 2008;38:893-916
6. Massoud A, Mahyar A, Salavati et al. Sensitivity, specificity and predictive value of clinical trunk muscle endurance test in low back pain. Clinical rehabilitation 2007;21:640-647.
7. Reiman M P, Krier A D et al. Comparison of different trunk endurance testing methods in college aged individuals. The international

- Journal of sports Physical therapy. 2012 Oct;7(5):533-539.
8. Strand S L, Hjelm J,Shoepe T C, Fajardo M A. Norms for an isometric muscle endurance test. Journal of human kinetic. 2014 April,40:93-102
9. Axler CT, McGill SM. Low back loads over a variety of abdominal exercises searching for the safest abdominal challenge. Med sci Sports Exercise 1997 june;29(6):804-11
- 10.Bliss L, Teeple P. Core Stability: the centrepiece of any traning program; Curr Sporys Med Rep. 2005 jun;4(3):179-83.
- 11.Ekstrom RA, Donatelli RA, Carp KC. Electromyographic analysis of core trunk, hip, and thigh muscles during 9 rehabilitation exercises. Orthop Sports Phys Therapy.2007;37(12):754-62
- 12.Schellenberg KL, Lang JM, Chan KM, Burnham RS. A clinical tool for office assessment of lumbar spine stabilization endurance: prone and supine bridge maneuvers. Am Phys Med Rehabilitation 2007;86(5):380-6.
- 13.Devangi Desai , Effects of low back pain on anterior core muscle endurance in college aged individuals. International Journal of Health Sciences & Research. 2018 Jan;8(1):116-121
- 14.Bohannon R.. The prone bridge test: Performance, validity, and reliability among older and younger adults. Journal of bodywork and movement therapies. 2018;22:385-89
- 15.Gupta G, Alok M. ;Effectiveness of Plank Exercise in Low Back Pain. International Journal of Science and Research.2020 Octomber;9(10):1182-86
- 16.Dr Pardeshi T, Dr.Grover P, Dr. Phadke S. Study the correlation between muscular endurance of timed forearm plank test with BMI in sedentary urban females. International Journal of Science and Research. 2020 August;9(8):860-65

Conflict of interest: None
Funding: None
Cite this Article as: Pandit Y, Bisen R, Kalra K. Norms Of Prone Plank Testing For Isometric Endurance Assessment In Indian Healthy College Aged Individuals - An Observational Cross Sectional Study. Natl J Integr Res Med 2021; Vol.12(4): 51-55