ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 10, Issue, 04(D), pp. 31844-31849, April, 2019

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

CORRELATION OF BODY MASS INDEX WITH FOOT POSTURE AND CORE STABILITY IN THE YOUNG ADULT POPULATION

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DOI: http://dx.doi.org/10.24327/ijrsr.2019.1004.3349

ARTICLE INFO

Article History:
Received 13th January, 2019
Received in revised form 11th February, 2019
Accepted 8th March, 2019
Published online 28th April, 2019

Key Words:

body mass index, foot posture, core stability, young adult

ABSTRACT

Introduction: Obesity causes various systemic diseases and musculoskeletal impairments. Increasing body adiposity causes an increase in loading of the joints leading to degeneration, pain. Core muscles are responsible for stability and balance; weak core musculature makes the body more prone to injury.

Aim: To correlate body mass index with foot posture and core stability in the young adult population

Methodology: Cross-sectional study wherein 40 subjects were taken fulfilling inclusion and exclusion criteria. Body mass index was calculated first, following which foot posture was assessed using the Foot Posture Index. Core stability was assessed using time to failure prone plank test.

Results: There was a positive correlation of BMI with both left and right feet (p-value=0.0064, p-value=0.0299) respectively. Also there was a significant correlation between BMI and core stability (p-value=0.0376)

Conclusion: There was a correlation between BMI and foot posture as well as a correlation between BMI and core stability in the young adult population.

INTRODUCTION

Statistics show that in 2016, more than 1.9 billion adults 18 years and older were overweight and of these over 650 million were obese.[1] WHO (World Health Organization) defines overweight and obesity as abnormal or excessive fat accumulation that may impair health.[1]Body composition can be assessed by the body mass index (BMI), waist circumference, waist to hip ratio and skin girth measurement. Body mass index is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2).[1]

Classification of body mass index for Asian Indians is as follows:[2]

Normal BMI: 18.0-22.9 kg/ m^2
Overweight: 23.0-24.9 kg/ m^2
Obesity : > 25 kg/m^2 [4]

Obesity is associated with a number of musculoskeletal conditions such as osteoarthritis, low back pain, gait disturbances, osteoporosis, soft tissue complaints and is responsible for significant disability and impaired quality of life.[1] A meta-analysis that was done to examine the relationship between body mass index and the risk of knee osteoarthritis showed obesity as a robust risk factor for knee OA.[4]

The pathophysiology of obesity-related osteoarthritis is multi-factorial which is structural joint damage from both mechanical factors and metabolic factors, the mechanical factors being increased forces about the joint, decreased muscle strength and altered biomechanics.[5]

Weight bearing subtalar pronation is accomplished by the coupled movements of eversion of the calcaneus and plantarflexion and adduction of the head of the talus.[6]Study done on older adults showed that in comparison to non-obese individuals, obese individuals showed flatter feet, reduced inversion-eversion range of motion and higher peak plantar pressures while walking; bodyweight was found to be associated with elevated loading of foot.[7]

The core acts as an anatomical base for motion of the distal segments, that is proximal stability for distal mobility.[8]The core is defined as a double-walled cylinder consisting of the abdominal muscles (transverse abdominis, internal and external obliques and rectus abdominis) in the front, the paraspinals and gluteal at the back, the roof being the diaphragm and the pelvic floor musculature and hip musculature as the bottom.[11]The abdominal wall (obliques and the transerversus abdominis muscle) form a "hoop" around the abdomen where the

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abdominal wall is the anterior aspect and the thoracolumbar fascia with its attachment is the posterior aspect, which provides stability to the lumbo-pelvic region and compensates for lack of stiffness due to injury through increased muscle activity.[10]

W. Ben Kibler *et al*. defined core stability as "the ability to control the position and motion of the trunk over the pelvis and leg to allow optimum production, transfer and control of force and motion to the terminal segment in integrated kinetic chain activities."

Active and passive elements contribute to core stability; the active muscular elements contribute to the stability through intra-abdominal pressure, spinal compressive forces and hip and trunk muscle stiffness.[11] Simultaneous contraction of the abdominals, diaphragm and pelvic floor muscles causes increase in abdominal pressure and greater trunk stiffness, thus further stabilizing the spine.[8, 11]

Need for study: Report presented by NFHS (National Family Health Survey) 2015-16 Mumbai, Maharashtra district fact sheet showed 34% urban women obese / overweight and 37.9% urban men obese/ overweight in 15-49 years of age.[12]

In today's day and age, our young adults lead a more sedentary kind of lifestyle. This could be attributed to long study hours for students who are under a lot of pressure to perform well leaving less time for any physical activity. Increasing number of children in India are tending to become obese who as adolescents and adults suffer from various cardiovascular, musculoskeletal or psychological impairments.

Due to ever increasing job demands, long working hours, desk job working adults also lack physical activity in their day to day life. This sedentary lifestyle and lack of physical activity tend to make our young adults overweight / obese. Research done in the elderly population as well as in children, less research done in the young population cohort. Research done would be helpful as a part of preventive rehabilitation.
Hence the need to study the correlation of body mass index with foot posture and core stability in the young adult population.

MATERIALS AND METHODOLOGY

Type of Study: Cross-sectional study.
Population: Young adult population.
Duration of study: Six months.

Sample Design

Type of Sampling: Convenience sampling
Sample Size: 40
Location: K.J. Somaiya College of Physiotherapy, Sion, India.

Selection Criteria

Inclusion Criteria

- Asymptomatic adults in the age group of 18-35 years of age
- Subjects willing to participate in the study

Exclusion Criteria

- Any individual suffering from low back pain, foot pain, plantar fasciitis
- History of trauma or injury to the lower extremity in the past year affecting activities of daily living
- Any individual suffering from cognitive defects and not able to perform the study

Materials used

- Pen
- Data record sheet
- Weighing machine
- Measuring tape
- Stopwatch
- Foot posture index scoring sheet

Procedure

- Institutional ethical approval was taken before undertaking this study. Subjects willing to participate and fulfilling the inclusion and exclusion criteria were taken. Informed consent of the subject was taken beforehand.
- Outcome measures used were:

Foot Posture Index

Validity and reliability: Rasch analysis confirms the construct validity of the six-item instrument and the linearity of the metric output (PSI=0.88).[13]
The FPI-6 demonstrated inter rater reliability and is a quick, simple and reliable clinical tool (Kw = 0.86).[14]

Prone plank Test

Validity and reliability: Validity- Test showed validity; ICC was 0.99; CV was 2.0 ± 1.56% [15]
Test retest reliability and validity of the plank exercise (R = 0.966) [16]

For calculating body mass index, first height and weight of the subject was calculated using a measuring tape and weighing machine respectively; body mass index was then calculated using the formula:

$BMI = \text{weight (kg)} \div (\text{height})^2$

The Foot Posture Index

Foot posture was assessed using the Foot Posture Index

The subject was told to stand in their relaxed stance position with double limb support. The subject was instructed to stand still with their arms by the side and looking straight ahead. During the assessment, ensuring that the patient does not swivel to try to see what is happening was important as that would significantly affect foot posture .[17]

The six clinical criteria employed in the FPI – 6 are: [17]

i. Talar head palpation
ii. Supra and infra lateral malleolar curvature
iii. Calcaneal frontal position
iv. Prominence in the region of the talonavicular joint
v. Congruence of the medial longitudinal arch
vi. Abduction / Adduction of the forefoot on the rearfoot [20]

Fig 1 Talar head palpation

Fig 2 Supra and infra lateral malleolar curvature

Fig 3 Calcaneal frontal position

Fig 4 Prominence in the region of TNJ

Fig 5 Congruence of the MLA

Fig 6 Abd/add of the forefoot on rearfoot

Core stability

Evaluation of core stability was done using a single time to failure prone plank test. The correct positon of the plank test was demonstrated and time for which they can hold this correct position was noted.

Fig 7 Prone plank test

RESULTS

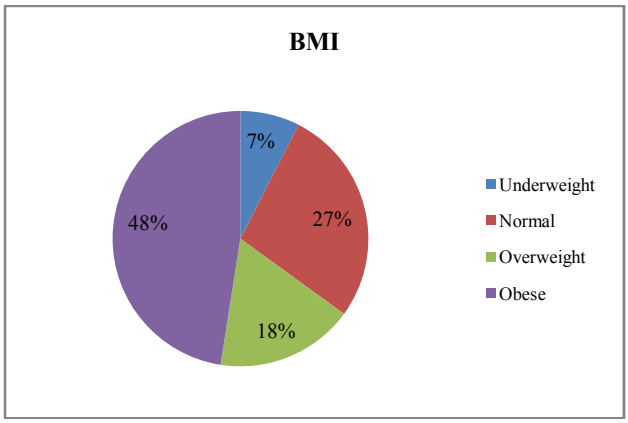
Data was analysed using Graph Pad Instat software version 3.10. Spearman correlation test was used. Study was conducted on 40 asymptomatic adults

Table 1 Mean and standard deviation of variables

Variables	Mean	Standard deviation
Age (years)	21.5	3.030
Weight (kg)	58.425	11.842
Height (cm)	154.304	5.439
BMI(kg/m^2)	24.5075	4.565
FPI (left)	4.25	2.035
FPI (right)	4.275	2.253
Core stability (s)	29.99	17.436

Table 2 Frequency and percentage of subjects in the underweight, normal, overweight and obese category

BODY MASS INDEX	FREQUENCY	PERCENTAGE
Underweight (<18)	3	7
Normal (18-22.9)	11	27
Overweight (23-24.9)	7	18
Obese (>25)	19	48

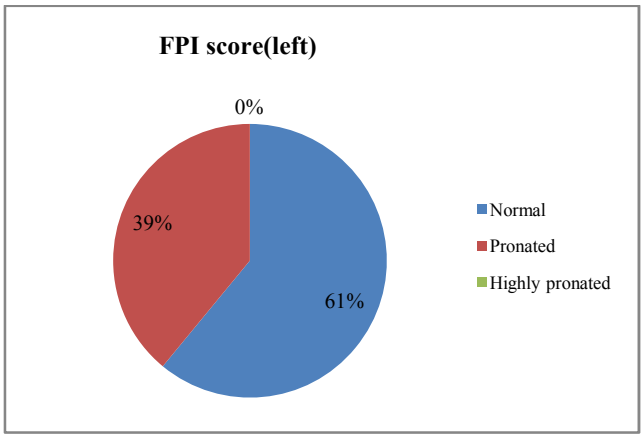


Graph 1 Percentages of subjects in underweight, normal, overweight and obese category of body mass index

Inference: Pie chart showing 7% underweight, 27% normal, 18% overweight and 48% obese subjects

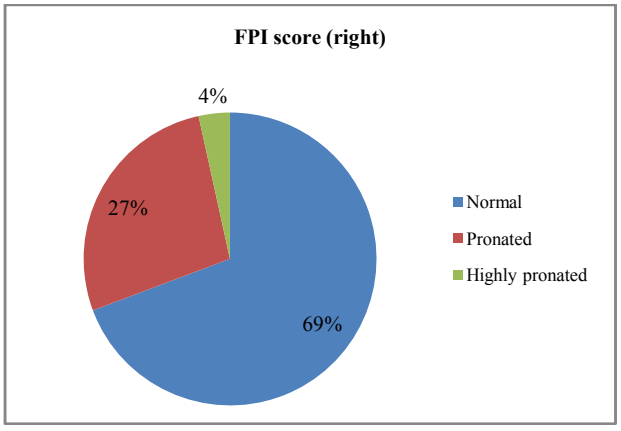
Table 3 Frequency and percentage of subjects in normal, pronated and highly pronated category of left and right feet

FPI score category	LEFT		RIGHT	
	Frequency	Percentage	Frequency	Percentage
Normal (0 to +5)	25	61	28	69
Pronated (+6 to +9)	15	39	11	27
Highly pronated (10+)	0	0	1	4



Graph 2a Pie chart showing percentages of left feet in the normal, pronated and highly pronated category

Inference: 61% normal, 39% pronated and 0% in highly pronated category

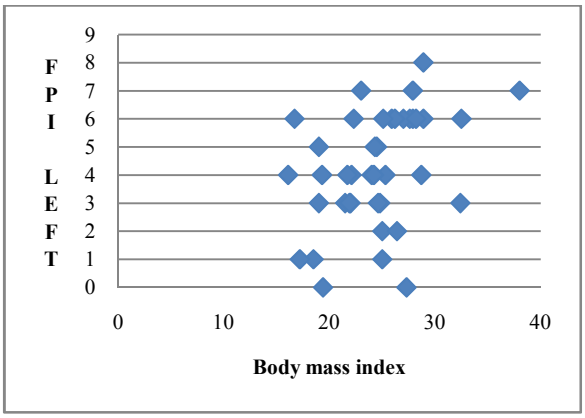


Graph 2b Pie chart showing percentages of right feet in the normal, pronated and highly pronated category

Inference: 69% normal, 27% pronated and4% in highly pronated category

Table 4: Correlation between BMI and FPI (left)

BMI		FPI(left)		r- value	p-value	Significance
Mean	SD	Mean	SD			
24.5075	4.565	4.25	2.035	0.4239	0.0064	Very significant

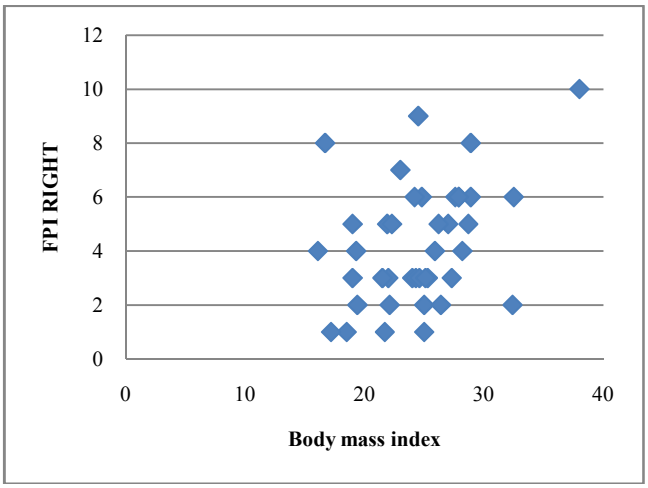


Graph 3 Correlation between body mass index and FPI (left)

Inference: Graph 3 shows positive correlation between body mass index (x axis) and foot posture index left (y axis); p value being 0.0064.

Table 5 Correlation between BMI and FPI (right)

BMI		FPI(right)		r- value	p-value	Significance
Mean	SD	Mean	SD			
24.5075	4.565	4.275	2.253	0.3436	0.0299	Significant

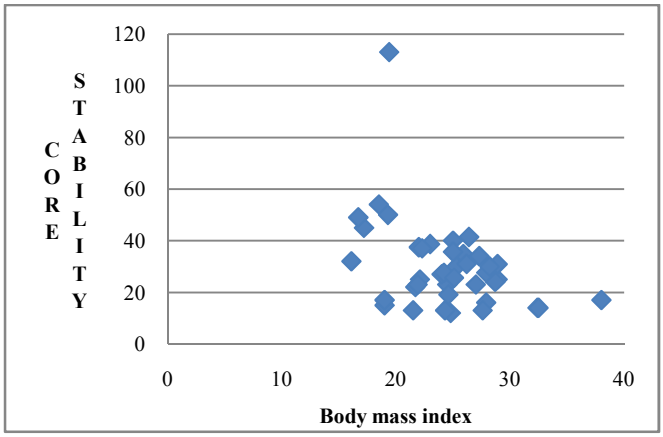


Graph 4 Correlation between body mass index and FPI (right)

Inference: Graph 4 shows positive correlation between body mass index (x axis) and foot posture index right (y axis); p value being 0.0299.

Table 6 Correlation between body mass index and core stability

BMI		Core stability		r- value	p-value	Significance
Mean	SD	Mean	SD			
24.5075	4.565	29.99	17.436	-0.3299	0.0376	Significant



Graph 5 Correlation between body mass index and core stability

Inference: Graph 5 shows negative correlation between body mass index (x axis) and core stability left (y axis); p value being 0.0376

DISCUSSION

This study was conducted after approval from the Institutional ethical committee to correlate the body mass index with foot posture and core stability in the young adult population. Subjects who fulfilled the inclusion and exclusion criteria were taken.

Table 1 shows the mean and standard deviation of the variables that were measured.

The body mass index of the subject was first calculated by first calculating the weight and height of the individual, foot posture was analysed using the foot posture index and core stability using the prone plank test.

Data analysis revealed a correlation between BMI and FPI (left) with the coefficient of correlation being 0.4239 and p-value 0.0064 as seen in Table 4. Graph 3 shows a scatter diagram, the correlation of body mass index with FPI (left) where values of BMI are plotted on the x axis and values of FPI plotted on y-axis. Similarly, Coefficient correlation of BMI and FPI (right) was 0.3436, p value being 0.0299 as seen in table 5 and graph 4 .Analysis also revealed a correlation between BMI and Core stability wherein r = -0.3299 and p value being 0.0376. Graph 5 with BMI values plotted on the x axis and core stability (s) on the y axis.

The results of this study is in conjunction with a previous study done by Sami S Alabdulwahab and Shaji John Kachanthu where 39 non athletic male students were taken in the study and BMI, FPI and core stability was analysed. The results were as follows; BMI and FPI r=0.5 and p = 0.001, BMI and CS r= -0.34, p=0.036. Their findings suggest that there is reduction in the arch of the foot due to increased body mass causing increased elevated loading of the foot. There is increasing amount of stresses applied to the foot directly via increased body weight and indirectly via alterations to the foot. [18]This has an effect on the overall lower limb kinetic chain.

Study done by Zachary F.Lerner *et.al*., on the effect of obesity on lower extremity function during walking in two speeds exhibited altered knee kinematics at the faster speed and pelvic kinematics at both speeds in obese individuals. The lower extremity force requirement per skeletal muscle tissue was seen to be greater in obese individuals that may contribute to altered kinematics and increase risk of musculoskeletal injury/pathology.[19]

Obesity is associated with foot pain and is related most strongly associated with fat mass particularly in android individuals; carrying excess load in the abdomen region may affect a person's stance or gait and load the foot differently.[20]

Therefore the effect of obesity on foot posture and function should be part of rehabilitation as well as awareness about the ill-effects on at risk individuals.

There is adipose tissue accumulation that occurs in the abdominal region of obese/overweight individuals. Obesity is also associated with increased lipid accumulation between and within skeletal muscles fibres which is associated with decreased physical strength and impaired physical function. [21]

Older adults who have poor trunk muscle composition (higher levels of fat infiltration) appear to be at a greater risk of reduced mobility-related function over time, and are more pronounced in those persons with a history of at least moderate back pain .[22]

A study done by Hazheer Rasif, Jianxong Wang concluded that core muscle function negatively correlated with body composition variables; significant correlation was found in men while in women only front bridge performance showed correlations, not side bridge time. Their results suggested that poor body composition results in poor core muscle function.[23]The results of this study are in conjunction with the present study.

A study done on the effectiveness of core stabilization exercises and routine exercise therapy in management of pain in chronic non-specific low back pain concluded that core stabilization exercises is more effective than routine physical therapy in terms of greater reduction in pain.[24]

Given the increasing number of young adults being overweight and obese, poor core muscle function would be more prevalent in them thus putting them at risk of musculoskeletal conditions like low back pain and injuries. Core muscle strength and stability should be taken into consideration while evaluating the individual and also should be part of rehabilitation.

There were limitations to the present study; a small sample size was taken. Also the sample population was female. A greater sample size should be taken and males should be included in the study. Other variables of body composition like waist circumference, waist hip ratio, skin girth measurement should be considered and correlated with foot posture and core stability.

Thus this study correlated body mass index with foot posture and core stability in the young adult population.

CONCLUSION

This study correlated body mass index with foot posture and core stability in the young adult population. Analysis revealed that there is a significant correlation between BMI and foot posture and core stability.

References

1. World Health Organization, Obesity and Overweight, (16th February 2018), Available from: URL: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight#
2. A Misra, P Chowbey, BM Makkar *et al*. for Consensus Group. Consensus Statement for Diagnosis of Obesity, Abdominal Obesity and the Metabolic Syndrome for Asian Indians and Recommendations for Physical Activity, Medical and Surgical Management. Available from: URL: http://www.japi.org/february_2009/R-1.html
3. A Anandacoomarasamy, I Caterson, P. Sambrook M Fransen and L March The impact of obesity on the musculoskeletal system *International Journal of Obesity* (2008) 32, 211–222; doi:10.1038/sj.ijo.0803715; published online 11 September 2007.
4. Zheng, H., & Chen, C. Body mass index and risk of knee osteoarthritis: systematic review and meta-analysis of prospective studies. BMJ open, 2015; 5(12), e007568. Doi: 10.1136/bmjopen-2014-007568
5. King, L. K., March, L., & Anandacoomarasamy, A. Obesity & osteoarthritis. *The Indian journal of medical research*. 2013; 138(2), 185–193.
6. RobRoy M. "The Ankle and Foot Complex". In: Pamela L, Cynthia N. Joint Structure and function. 5th ed. Jaypee Brothers: New Delhi: 440-481
7. Paul B, Donna M., Urquhart, Karl L. Foot posture, range of motion and plantar pressure characteristics in obese and non-obese individuals. Gait and Posture. 2014; volume 41 issue 2, pages 465-469
8. W. Ben Kibler, Joel Press and Aaron Sciascia, The Role of Core Stability in Athletic Function, Sports Med 2006;36(3) :189-198
9. Angela H, Kevin T, Duncan F, Allan W and Iain S. Optimizing Performance by Improving Core Stability and Core Strength (2008) Sports Med;38(12);998-1008
10. Diane Dalton. "The Vertebral Column". In: Pamela L, Cynthia N. Joint Structure and function. 5th ed. Jaypee Brothers: New Delhi: 139-191
11. Willson, John & Dougherty, Chris & Ireland, Mary & Davis, Irene.Core Stability and Its Relationship to Lower Extremity Function and Injury. *The Journal of the American Academy of Orthopaedic Surgeons*. 2005; 13. 316-25.10.5435/00124635-200509000-00005.
12. National family health survey-4 (2015-16), District fact sheet Mumbai Maharashtra. Available from: http://rchiips.org/NFHS/FCTS/MH/MH_FactSheet_519_Mumbai.pdf
13. Keenan AM, Redmond AC, Horton M, Conaghan PG, Tennant A, The Foot Posture Index: Rasch analysis of a novel, foot-specific outcome measure, Arch Phys Med Rehabil. 2007; Vol 88
14. Stewart M and Jill F. Inter- rater reliability of foot posture index (FPI-6) in the assessment of the paediatric foot Journal of Foot and Ankle Research2009; 2:26
15. Tom K. Tong, Shin Wu, Jinlei Nie. Sport specific endurance plank test for evaluation of global core muscle function. Physical Therapy in Sport.July 15, 2013; 15(1), pp. 58-63.
16. Saporito, Gia; Jernstedt, Gretchen; and Miller, Holden, Test-Retest Reliability and Validity of the Plank Exercise (2015). Linfield College Student Symposium: A Celebration of Scholarship and Creative Achievement. Event. Submission 17.
17. Anthony Redmond. Easy quantification of standing foot posture six item version USER GUIDE AND MANUAL. (August, 2005), 1-19
18. AlAbdulwahab, S.,& Kachanathu, S. J. Effects of body mass index on foot posture alignment and core stability in a healthy adult population. *Journal of exercise rehabilitation*.2016;12(3),182–187. doi:10.12965/jer.1632600.300
19. Zachary F. Lerner, Wayne J. Board, Raymond C. Browning. Effects of obesity on lower extremity muscle function during walking at two speeds. Gait and Posture. 2014;39 (2014) 978-984
20. Tanamas, S. K., Wluka, A. E., Berry, P. , Menz, H. B., *et al*. Relationship between obesity and foot pain and its association with fat mass, fat distribution, and muscle mass. Arthritis Care Res, 2012; 64: 262-268. doi:10.1002/acr.20663
21. Lance M Bollinger, Potential contributions of skeletal muscle contractile dysfunction to altered biomechanics in obesity. Gait & Posture. 2017; Vol.56 pg. 100-107, https://doi.org/10.1016/j.gaitpost.2017.05.003
22. Gregory H, Eleanor M, Simonsick, *et al*. Trunk Muscle Composition as a Predictor of Reduced Functional Capacity in the Health, Aging and Body Composition Study: The Moderating Role of Back Pain, *The Journals of Gerontology*: Series A, November 2005, Volume 60, Issue11,Pages1420-1424,https://doi.org/10.1093/gerona/60.11.1420
23. Hazheer R, Jianxiong W. Negative correlation between core muscle function and body composition in young people aged 18-30 years. *International Journal of Sport, Exercise and Health Research*. 2017; 1(1): 49-53
24. Waseem A, Muhammad & Karimi, Hossein & Gilani, Syed. Effectiveness of core stabilization exercises and routine exercise therapy in management of pain in chronic nonspecific low back pain: A randomized controlled clinical trial. *Pakistan Journal of Medical Sciences*. 2017; 33. 10.12669/pjms.334.12664.

How to cite this article:

Nisha Dhasal, Zeba Barodawala., 2019 Correlation of Body Mass Index with Foot Posture And Core Stability in the Young Adult Population. *Int J Recent Sci Res.* 10(04), pp. 31844-31849. DOI: http://dx.doi.org/10.24327/ijrsr.2019.1004.3349

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