Correlation of body mass index and strength of plantar flexors in healthy, asymptomatic individuals

Sadhana Vasani[1*], Dr. Mansi Shingala[2], Dr. Dinesh Sorani[3]

[1]Final Year Student, Govt. Physiotherapy College, Jamnagar, India.
[2]Tutor cum Physiotherapist, Govt. Physiotherapy College, Jamnagar, India.
[3]Principal, Govt. Physiotherapy College, Jamnagar, India.

[*1]Corresponding Author:
Sadhana Vasani,
Government Physiotherapy collage,
Jamnagar, Gujarat, India.

Abstract

Background: BMI is an indicator of relative obesity which can be used to screen for weight categories that may lead to many health problems. Increased BMI along with weakness of calf may lead to plantar fasciitis and Achilles tendinopathy. As the Literature is lacking for correlation between BMI and plantar flexors strength, this study was conducted with the same objective.
Method: 120 participants were taken for standing heel rise test. BMI was considered according to Indian population. Best of 3 measurements was taken into consideration for data analysis for right and left side.
Result: Correlation was done for all 4 categories (underweight, normal, overweight and obese) with number of heel rise. Significant negative correlation was found for BMI and number of heel rise for both sides.
Conclusion: Number of heel rise decreases with increased BMI value. Special attention is required for calf muscle evaluation procedure for overweight and obese population.

Keywords: Plantar flexors, Manual muscle testing, Body mass index.

INTRODUCTION:

Ankle plantar flexors are muscle of posterior compartment of leg. Ankle plantar flexor strength has an important role in standing balance , walking ability and most activities of daily living.[1] Body Mass Index (BMI) is an indicator of relative obesity which can be used to screen for weight categories that may lead to many health problem such as plantar fasciitis, Achilles tendinopathy and chronic heel pain.[2-4] Waist Circumference and Waist Hip ratio is also sensitive for fat level distribution and its relation to the disease risk.[5] Furthermore, weakness of calf muscle may lead to increased chances of development of these kind of musculoskeletal problems. Manual Muscle Test (MMT) is most commonly used clinical method to assess the strength of plantar flexor muscles. [6] According to the evidence it is found that the therapist should be aware that strength deficits in the plantar flexors which are common, particularly with advancing age and the strength deficits can affect the heel rise portion of the gait cycle and thus reduce gait speed.[6]

NEED OF STUDY:

As the literature is lacking for correlation between BMI and plantar flexors strength, this study was conducted to find correlation between BMI and strength of plantar flexors**.**

AIM:

To find correlation between BMI and plantar flexors strength in healthy asymptomatic individuals.

MATERIALS AND METHOD:

This Correlation study was conducted on 120 individuals (female- 60, male-60) in age group of 18-25 years. Subjects were enrolled on the basis of inclusion and exclusion criteria. Individuals were recruited from Physiotherapy College and OPD. Convenient sampling was used for data collection in the study. Inclusion criteria for the study were kept as subjects with age group between 18-25 years, willingness to participate and able to understand the technique. Subjects with any pathological condition, any deformity present in lower extremities and those who are doing regular physical activity that can affect the number of heel rise were excluded. Each subject filled out the subject information sheet and signed informed consent form. Standard weighing scale (OMRON: HN-286), Data collection sheet, stadiometer (Krups), tape measure and other stationary items were used.

PROCEDURE:

After Familiarization with the procedure, Demographic data such as age, gender, weight and height was taken of all the subjects. BMI (kg/m^2) was calculated with weight in kilogram divided by the height in meter square.[7] Waist Circumference was taken with the subject standing and arms at the sides, Feet together and abdomen relaxed, a horizontal measure was taken at the narrowest part of the torso (above the umbilicus and below the xiphoid process). Hip girth was taken with the subject standing erect and feet together. A horizontal measure was taken at the maximum circumference of buttocks. **[8]** This measurements were used in a waist-hip Ratio measurement.[9] The participants were then asked to stand on one limb having knee extended with one or two finger

support. They were then asked to perform complete heel rise from floor consecutively through maximum available range. Subject no longer achieves 50% of initial plantar range and/or deviations in posture were considered for termination of the test. The test was done thrice for each extremity. 5 minutes of rest was given between the test repetitions to avoid the effect of fatigue. The same procedure was repeated in another lower limb and best of three was taken for data analysis. Photograph shows the technique of heel rise performed.

Photograph: Right Heel Rise technique

RESULTS:

Data of 120 (M=60, F=60) participants were analysed by SPSS 20 and Microsoft Excel 2007. Mean Age of the participants = 19.92±1.27 years. Pearson Correlation test was used to find correlation between Body Mass Index (BMI), Waist Circumference (WC) and Waist- Hip Ratio (WHR) with number of heel rise. Result Showed Significant negative correlation for number of heel rise with BMI, waist circumference and WHR (Table 1). All the Correlations were significant at 0.01 levels.

Table 1: Correlation values For BMI, WC and WHR with no. of heel rises (n=120)

	BMI	WC	WHR
RT. Heel Rise	-0.358	-0.413	-0.336
LT. Heel Rise	-0.350	-0.416	-0.351

Classification for Indian BMI values was considered for different category of BMI [7]:
Underweight: <18.5 kg/m2, Normal: 18.5-22.9 kg/m2, Overweight: 23.0-24.9 kg/m2 and obese: >=25 kg/m2
Numbers of subjects in each category in present study were- Underweight=31, Normal=31, Overweight=26 and obese=32.
Graph 1 shows decrease in numbers of heel rises with increase in BMI values.

Graph1: number of heel rise with Different BMI

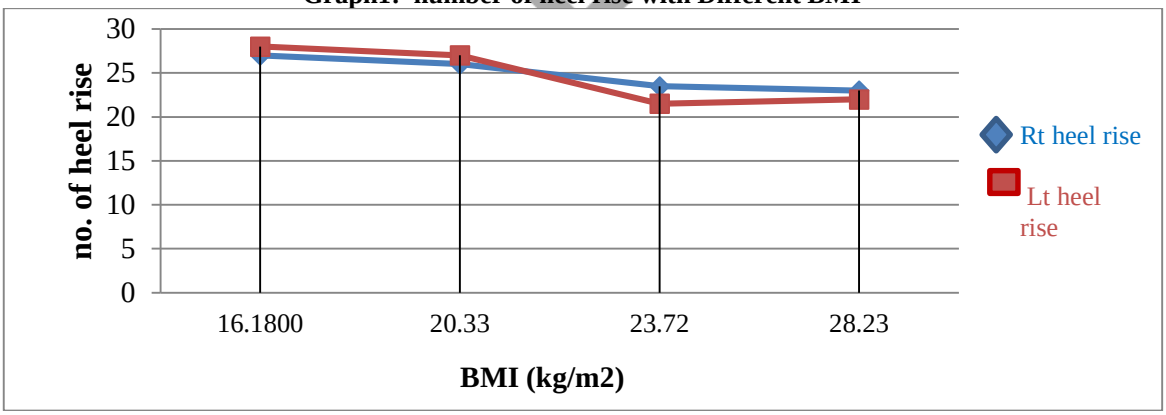


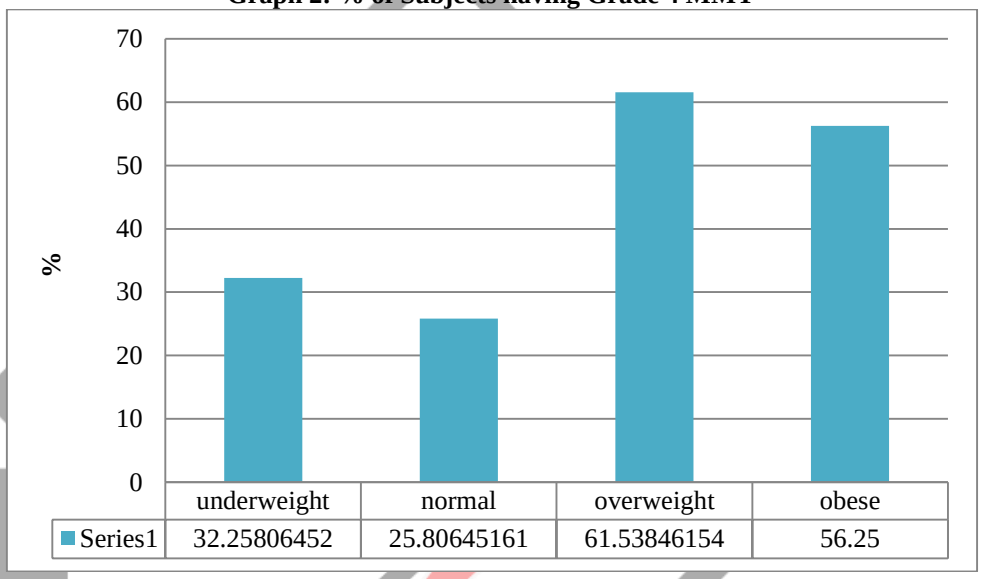
Table 2 Shows Pearson Correlation values for male and female (n=60 each), which showed Significant negative correlation for number of heel rise with BMI, waist circumference and WHR.

Table 2: Correlation of heel rise with BMI, WC and WHR for male and female

	MALE (n=60)		FEMALE (n=60)	
	RT. Heel Rise	LT. Heel Rise	RT. Heel Rise	LT. Heel Rise
BMI	-0.294	-0.338	-0.430	-0.362
WC	-0.411	-0.445	-0.437	-0.402
WHR	-0.399	-0.429	-0.321	-0.313

Further, when assessed for the % of participants having Grade 4 of MMT for Bilateral Calf muscles (=who completed heel rises between 2 to 24), result showed >50% of individuals having grade 4 in overweight and obese category according to Indian Population BMI which means there are less number % of subjects having grade 5 of MMT. Graph 2 Shows % of Subjects having grade 4 of MMT in each category of BMI.

Graph 2: % of Subjects having Grade 4 MMT



DISCUSSION:

This Study was conducted to find the relation between BMI and Strength of planter flexor muscles in healthy asymptomatic young individuals. Result Showed Significant negative correlation for number of heel rise with BMI, waist circumference and WHR for male and female both. Further, when assessed for the % of participants having Grade 4 for bilateral Calf muscles (=who completed heel rises between 2 to 24), result showed >50% of individuals having grade 4 in overweight and obese category according to Indian Population BMI. With high BMI value, calf muscle has to work more to lift the weight of body on a single limb for several repetitions. Increased weight increases the stress impact placed on the lower extremity especially during gait.[3] Thus, there is need to either generate the range value given for normal strength of calf muscle or to introduce the calf strengthening exercises as a preventive measure for overweight and obese individual. Limitation of the study was that the Lifestyle was not taken into consideration.

CONCLUSION:

Number of heel rise decreases with increased BMI value and therefore special attention is required for calf muscle evaluation procedure for overweight and obese population.

FUTURE STUDY:

Study can be done for correlation between BMI and other muscles strength, also on other age group. Another study can be done on Long term follow up by giving calf strengthening exercises in the subjects having higher BMI value.

CONFLICT OF INTEREST: None.

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