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Original Research Article

Foot Health Status and Body Mass Index amongst College Students- A Cross-Sectional Survey

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Abstract: Obesity enforces additional loading on the loco-motor system, thereby unduly raising stress within connective-tissue structures and the potential for foot and ankle problems. Increased weight on the feet significantly increases contact areas, with increased pressure on these areas leading to increased foot problems such as pain, deformity and reduced joint mobility and reduction in foot function. This cross-sectional study examines the relation between obesity and self-reported pain in adults between age group 18-25 years in the five institutes of MGM campus, Kamothe, Navi Mumbai (N = 100). Demographic variables such as age, height and weight were recorded of participants having foot pain and their BMI was calculated. The relationship between Body Mass Index and allthe four domains of the FHSQ were investigated using Pearson's Correlation in SPSS software, version 16. We found statistically significant positive correlation between body mass index and foot pain (p=0.82), foot function (p=0.63), foot wear (p=0.59) and foot health (p=0.30). The prevalence of obesity is high in females than males. This study showed that an increase in body weight has a significant effect on the level of foot pain, normal foot function, the adequate fit of footwear, and general foot health as determined by the FHSQ. Our study demonstrated that foot pain, foot structure, and foot function are compromised by excess mass in young adults which resulted in functional limitations and a reduction in health-related quality of life, particularly in young adults classified as overweight and obese.
Keywords: Obesity, Foot Pain, Foot Health, Body Mass Index, Foot Health Status Questionnaire

INTRODUCTION

The ankle is a synovial hinge joint with a joint capsule and associated ligaments. The ankle and foot is a complex structure comprised of 28 bones (including 2 sesamoid bones) and 55 articulations (including 30 synovial joints), interconnected by ligaments and muscles [1]. The ankle/foot complex is a composition designed to optimize weight bearing and to contribute equally to stability and mobility of the lower extremity. It adapts to a variety of surfaces while permitting for innumerable activities and also absorbing weight bearing stresses placed during the same [2]. The ankle-foot complex is an elaborate mechanism functioning interdependently and providing a stable base of support by being a rigid lever for lower limb propulsion during walking, running, jumping etc [3].

In an individual with a normal weight, most of the joints of the lower limb are subjected to ground reaction forces of approximately three to six times body weight during a normal gait cycle especially during a single leg stance phase[3, 4]. On account of this it is generally hypothesized that as the body weight increases, these individuals sense greater joint loads than those with normal weight [5, 6]. Obesity is the up and rising serious problem all over the world not only among middle aged adults, but also amid children, teenagers, and young adults. Increase in weight is a consequence of multivariate factors. Of these factors contributing, stress appears to be predominantly important as stressful conditions set in motion a pattern of irregular diet, sedentary lifestyle and addiction, each being measured as independent factors resulting in obesity [7].

Stress will continue to be a major part and parcel in the life of every student who is contending against society norms to find his place in the

competitive world. Odd study hours, exam stress, peer pressure etc. add on to increased fast food consumption, increased soft drinks, improper stylish foot wear, watching television and playing games on the computer and lack of outdoor games [8]. As the body weight increases, burden on the feet radically increases the surface contact areas. Increased pressure in turn leads to augmented foot problems such as pain, deformity and reduced joint mobility [9-11]. The prevalence of overweight and obesity are ever increasing in this era owing to the elite lifestyle of individuals especially the students. Previous studies among university students in developing countries are evidence for high prevalence of augmented weight: India being 11%–37.5% amongst the age groups of 18–21 [12, 13]. Despite reports of poor foot health, the influence of obesity and overweight on adult foot has been overlooked. Hence, the objective of this work is to identify the prevalence of obesity amongst students with foot pain in the University Campus and explain the relationship between the Foot health status and Body mass index.

METHODOLOGY

This cross sectional study was conducted in the MGM Campus of Navi-Mumbai. The subjects participating were included from the different institutions such as MGM Medical College, MGM College of Engineering, MGM Dental College, MGM College of Management, MGM College of Nursing and MGM College of Physiotherapy which are a part of the MGM Campus. Convenience sampling method was implemented for conducting this study. Participants between age group 18-25 years with self reported foot pain were included in the study. The students incorporated in the study were under graduates from first to final year, interns and post graduates currently pursuing their education in this Campus.

The Ethical Clearance was obtained from the Institutional Research Committee. Written Informed Consent from the participants was acquired before starting the procedure. A total of 100 participants participated in the study. The purpose and method of this research was well explained to the subjects.

PROCEDURE: Initially the demographic data were recorded to enable the study population to be assessed in terms of name, sex, age, height and weight.

Height Measurement: Height was measured (to the nearest 0.5 cm) with the subject standing in an erect position against a vertical scale of the measuring tape stuck to the wall. The participant was asked to stand with his/her back against the wall. The scapulae, upper back and buttocks are in contact with the vertical wall. The weight of the participant should be evenly distributed on both feet. The participant was instructed to stand erect (stand up straight and look straight ahead). The participant's position was verified from the front and both sides. The steel ruler was brought onto the vertex of the head with sufficient pressure to compress the hair [14].

Weight Measurement: Body weight was measured (to the nearest 0.5 kg). The participant was asked to step up onto the scale and stand still over the centre of the scale feet 15 cm apart with body weight evenly distributed between both feet. The participant's arms were hanging freely by the sides of the body, with palms facing the thighs. The participant was asked to hold his/her head up, and face forward. The weight was then recorded in kilograms [14].

Body mass index: BMI was then calculated using the height and weight measurements of each participant. The revised consensus guidelines were used to classify the subjects as Underweight (<18.5 kg/m^2), Normal or lean BMI (18.5–22.9 kg/m^2), Overweight (23.0 –24.9 kg/m^2) and Obese (≥25 kg/m^2) [15].

Study Tool:

The Validated Foot Health Status Questionnaire (FHSQ) version 1.03 was used to determine the wellbeing of the foot. FHSQ measures foot specific health related quality of life incorporating the domains of functional ability, social functioning psychological wellbeing, somatic sensation (e.g. pain), and life satisfaction. This questionnaire is internally consistent and includes both physical and psychological variables [16, 17]. The questionnaire includes four domains: foot pain, foot function, footwear and general health.13 questions (Likert scale format) were included to assess foot health in terms of pain, function, footwear, and general foot health [17]. All data was tabulated in Windows Excel and transferred to a spreadsheet in the SPSS®1 software program, version 16. Statistical analysis was undertaken using Pearson's correlation coefficient for normally distributed data

RESULTS

The mean age of the subjects participating in the study was 22.28 +1.6942 Years. Out of the 100 students, 25 were males and 75 were females. The BMI when calculated showed that 34% were Normal (9 male & 25 female), 47% were Overweight (13 male & 34

female) and 19% were Obese (3 male & 16 female) according to the revised guidelines.

The below graphs illustrate the relationship between the Foot health status and Body mass index.

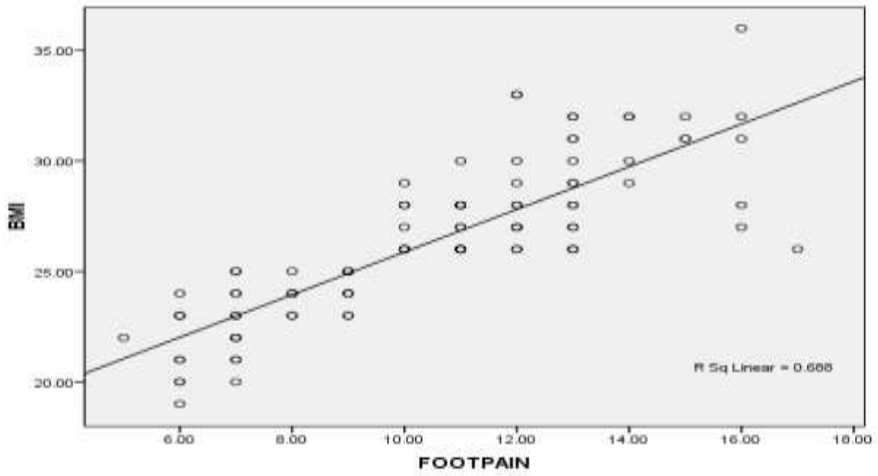

Fig 1: Shows correlation between BMI and Foot Pain domain

Inference: Correlation between BMI and Foot Pain shows that foot pain was positively correlated and highly significant with BMI (Pearson's correlation coefficient: 0.82, $p < 0.05$), which implies that participants with increased BMI had increased level of foot pain

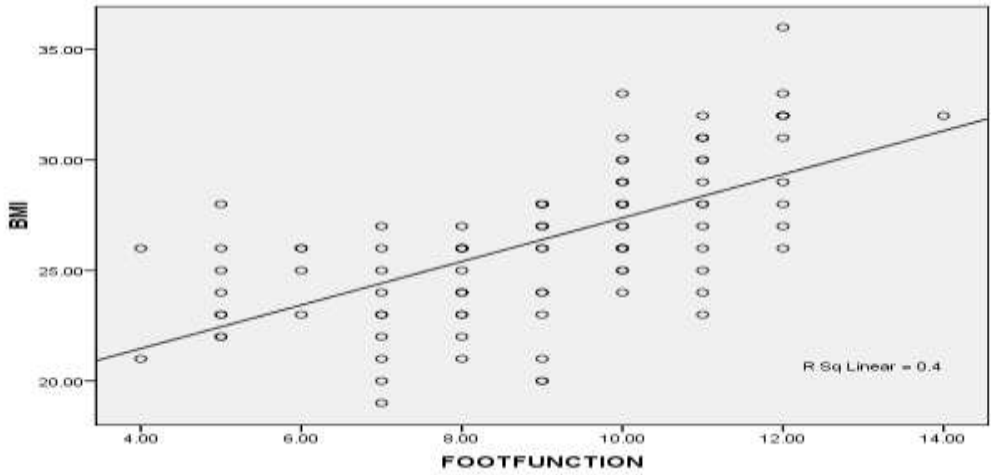

Fig 2: shows correlation between BMI and Foot Function domain

Inference: Correlation between BMI and Foot Function shows that foot function was positively correlated and moderately significant with BMI (Pearson's correlation coefficient: 0.63, $p < 0.05$), which implies that participants with increased BMI had increased level of difficulty in foot function

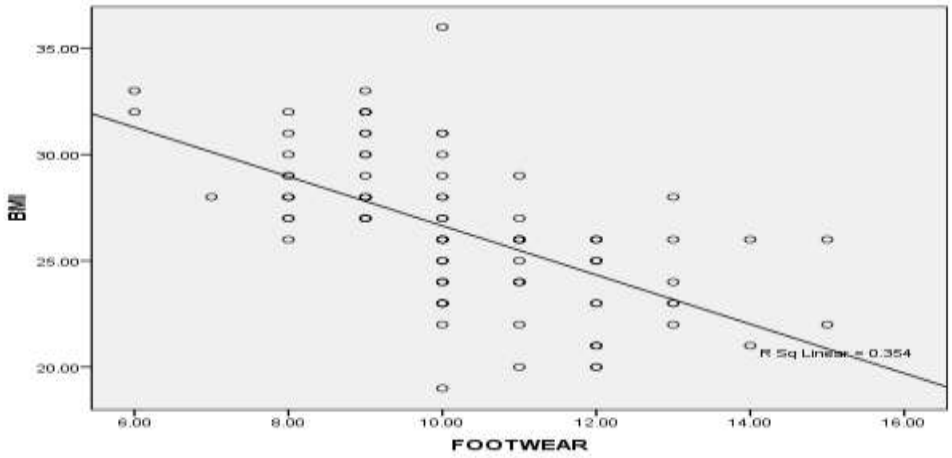

Fig 3: shows correlation between BMI and Foot Wear domain

Inference: Correlation between BMI and Foot Wear shows that foot wear was negatively correlated and moderately significant with BMI [Pearson's correlation coefficient: (-0.59), $p < 0.05$], which implies that participants with increased BMI had difficulty in finding appropriate shoes.

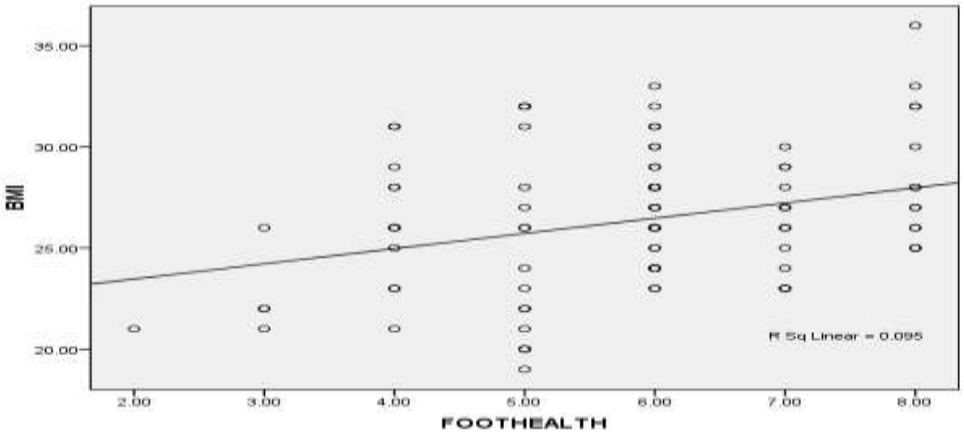

Fig 4: shows correlation between BMI and Foot Health domain

Inference: Correlation between BMI and Foot Health shows that foot health was positively correlated and having statistically low significance with BMI (Pearson's correlation coefficient: 0.30, $p < 0.05$), which implies that participants with increased BMI had poor foot health but not very profound.

DISCUSSION

Obesity has developed into a global pandemic recognized as a major public health concern. It is strongly linked to various lower extremity ailments mainly ankle and foot pain and dysfunction. The impact of increased weight on the foot and ankle has resulted in injurious changes to foot structure and function [18-20]. Overweight or obese adults are at a greater risk of developing foot pain however, not many studies have comprehensively examined the effects of increased weight on the feet of individuals in 18 to 25 years of age. Holli CH, Robert C. Mc Millen *et al.;* conducted a cross sectional study to determine the association between obesity and self-reported pain in a general population of adults. They concluded that the probability of obese adults experiencing foot pain is more likely [21]. Our study reflects a similar finding with the relation between foot pain and age, female sex and obesity are largely consistent with previous reports [22]. The significant increase in forces and pain over the foot especially when walking can be explained by increased body weight and flatfootedness [23].

Tanamas *et al.;* established that the outcome of obesity on foot pain was interrelated to an increase in adiposity, principally due to android distribution of fat. Similarly, in our study we hypothesize that foot pain may be an amalgamation of a mechanical effect via increased loading on the foot as well as a systemic effect due to increased body weight [24]. A study conducted by Butterworth *et al.;* further concludes that increased BMI and non-specific foot pain are strongly connected [25]. Also, Tanamas *et al.;* found that women have a higher prevalence of foot pain than men attributed to the wearing of shoes with an elevated heel [24]. Our study demonstrated that foot function also significantly deteriorated secondary to foot pain as established by FHSQ. This agrees with Song *et al.;* who revealed that even a little weight loss considerably improved the foot function by decreasing the dynamic plantar loading [26]. Butterworth *et al.;* in yet another study illustrated that the association between body composition and foot structure and function existed in 16 papers indicating that obesity shows planus, pronated dynamic foot function and increased plantar pressures [27, 28].

Price and Nestor in their study prove that foot size and shape is impacted along with the rest of the body increasing the foot depth and width with an increased body weight. This increases the mid foot contact areas on the ground. The altered physique and adapted gait patterns during obesity modifies the interaction between the individual and their foot wear placing greater demands on particular areas of the foot wear compared to their normal weighted counterparts [29]. Thus from our study we establish that to prevent further foot issues, modified foot wear designs should be considered for individuals with increased BMI. These individuals perceive that comfortable and appropriate foot wear are difficult to find and they are generally unsatisfied with their foot wear as their weight increases [30]. With all the above features increased BMI compromises the general foot health. Our study indicated that as the significance between BMI and general foot health observed was statistically low but having a positive correlation, we theorize that there may be other factors involved apart from BMI resulting in the deterioration of foot health.

CONCLUSION

This study indicated that, foot pain is highly prevalent, even in young people. The frequency of overweight subjects was observed to be more than obese and normal individuals amongst the students who reported foot pain. Also, females demonstrated increased BMI compared to males. This study showed that an increase in body weight has a statistically significant effect on the level of foot pain and normal foot function as determined by the FHSQ. The selection and adequate fit of footwear is inversely related to BMI, i.e. with increased weight it becomes difficult to find comfortable foot wear. The general foot health is dependent on multivariate factors apart from BMI.

We conclude that all student Universities need to tackle their obesogenic environment and to promote healthy life styles as proposed by the WHO Global Strategy on Diet, Physical Activity and Health to minimize dysfunctions especially of the foot.

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