A STUDY ON EFFECT OF HEEL HEIGHT OF SHOES ON SELECTED VARIABLE OF NORMAL GAIT PARAMETER AMONG YOUNG ADULT FEMALES OF ETHIOPIA.

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Abstract
The female youth are crazy about the personality/ appearance to mark them self as unique. As a result, footwear industries are producing different kind of footwear’s to match the demand of the customers. Our objective of this study was to determine the impact of different shoe heel height on selected gait parameters. For this purpose, randomly 30 healthy Ethiopian females were selected from Mekelle university campus. The lower limb length of selected subjects, were ranges from 80 to 98 cm and their age ranges from 19 to 21 years. Cross sectional approach, survey study design was used to investigate the impact of different heel height (0cm, 7cm, 10cm) to achieve our aim. Stop watch, measuring tape and ruler were used to find out the cadence, walking speed, step frequency, limb length and stride length. On analyzing the observed results a significant difference in mean values of selected gait parameters were found, such as step frequency on wearing sleepers 58.617±4.4167 steps, low heel 64.341±5.8171 and high heel 68.755±4.9569 are required to cover 45 meter distance and similar on other parameters. More over the study found the impact heel shoes has an effect of time dependent variable as compare to time independent variable. However, with test retest method used and average was taken for each of the selected gait parameter to compensate human error in the study.

The conclusion of this study favor that, to maintain comfort and to reduce the chance of injury, young females should opt for flat shoes for their daily activities.

Keywords: Heel Shoes, Gait Parameter, Females, Ethiopia, Survey.

INTRODUCTION
A natural gift bestow to youth specially to females towards the uniqueness like latest dress fashion and design to make themselves very attractive in their society. Their fashion ranges from different hats to shoes, western to Asian and so on. But it’s very hard to understand the effect of different dress and designs on their immature body structure especially on crazy shoes, with different size and heel heights. Earlier studies have shown very interesting cause of wearing different shoe heel, such as it is associated with its utility to gain a height advantage, look professional or stay with the trend of fashion. It is not entirely uncommon for a female to own numerous pairs of these shoes at one time. [Henderson P D 2001]

Though, there are many therapeutic usages as in the treatment of tendinitis and partial ruptures of the Achilles tendon [Canale S 1998]. On the other side the heeled shoes are getting higher and its inclines are getting more steeper with toe boxes getting more pointed [Lee, C.M 2001] and lead to turf toe, toe arthritis and so on. Even their chronic effects as a result of persistent and non-prescribed usage of different heel shoe has currently become a source of worry to clinicians and scientists alike.[Madubuchi Joseph Nwankwo: 2012]. Previous studies revealed that walking in high heeled shoes required more effort and overloaded the activity of the respiratory muscles as compared when subject walk barefooted. It appears that the higher the heel heights, the greater the effort required for walking.[Odebiyi DO et.al,2011], moreover study also found that long term high heel users has tendency to adapt shorten medial gastrocnemius muscle fascicles and thus increases in Achilles tendon stiffness[Cronin NJ. et al; 2012]. Thus the influence of various shoes on young girls' health has drawn much attention from the society and trying to find out that what kind of shoes are suitable for young girls.[Li Jianshe 2002]

The Purpose of this study is to determine the selected gait parameter of young female in relation to their different shoe heel height. Thus, the significance of this study is to highlight the fact that the different shoe heel height may change the gait pattern. The results of this study may be used to emphasize to implement intervention programs to turn off or minimize the health problems through the endowment of proper heel shoe selection among female youth.

METHODOLOGY
The present study have been carried out with cooperation of the female students ageing 19 to 21 years from, Mekelle University. To conduct this research, mouth to mouth advertisement undertaken among students. 80 girls were interested to be volunteer for this study. The selection of the subjects has been made on basis of interview and observation. The exclusion criteria laid down by the researchers as the subjects who are orthopedically impaired and having the history of recent injury to back and lower limb, suffered with any kind of disease and as well as nervous to walk on high heel shoe height. Among the interviewed candidates 30 participants are fit for the study. We requested the volunteers to get their three pair of shoes of different heel height (viz- 0 cm, 7 cm & 10 cm) at the time of study.

In next phase of the study sample were divided into five groups to avoid the threat to internal validity, and their conveniences time for their participation in study. Prior to the test we advice the participants not to take any kind of stimulants or heavy meals at least two hours before the test and to wear most loose and comfortable dress. At time of test we demonstrate the activity to the volunteers and took a signature at volunteer concern form. Each participant was instructed to walk 45 meters on concrete road with their own comfortable speed for three times wearing each type of shoe. Thus each volunteer has to walk 45 meter distance three times by wearing a single type of shoe and follow the same after wearing other two different heel shoes. At every walk all the variables are noted and after end of three walk an average was taken. To measure the variables three testers were appointed, the first tester finding the stride length with tailor tape, the second tester counting no.of steps in 45 meter walk,
and third tester counting the time to cover the distance by using Samsung stop watch.

RESULTS

Data reliability-

Prior to finding out the result the scholars tried out the reliability of data which has been collected with the help of three observers and each action by volunteer have been repeated three times. (Table 1) Reliability test by using cronbach’s Alpha stastics.

<table>
<thead>
<tr>
<th>Waking parameters</th>
<th>No. of steps</th>
<th>Strad length</th>
<th>Cadence</th>
<th>speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heel size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleepers</td>
<td>0.968</td>
<td>0.999</td>
<td>0.996</td>
<td>0.991</td>
</tr>
<tr>
<td>Low heel</td>
<td>0.974</td>
<td>0.997</td>
<td>0.977</td>
<td>0.930</td>
</tr>
<tr>
<td>High heel</td>
<td>0.935</td>
<td>0.997</td>
<td>0.957</td>
<td>0.963</td>
</tr>
</tbody>
</table>

As per stastical calculation (SPSS-16) the scholar found that the reliability of collected data are highly reliable and thread to reliability and validity of data can be nullifies.

DESCRIPTIVE ANALYSIS

As per the early discussed/stated assumption scholar found interesting stastics facts in the following selected gait parameters changes with respect to shoe heel variable, as mentioned in table(2) Table No- 2; Descriptive analysis on selected gait parameters by wearing different heel size shoes.

| Gait speed | On analyzing the walking speed of 30 girls we found that when girls are wearing sleepers their speed ranges from 117.4 to 201.5 cm/sec. Overall the average speed of walking of this sample(n=30) is 154.29± 28.01548 cm/sec. As per the stastical calculation a little error of 5.114690cm/sec was calculated. When the same group of girls tried to walk with low heel shoes, we saw that their walking speed varies from 108.9 to 313 cm/sec, though the average speed of walk is 136.21±36.5124 cm/sec. These samples have relatively low speed then sleeper walk. The chances of stastically error were much lesser i.e. 6.66624 cm/sec. After walking with low heel, the same group of girls are again walked with high heel shoes, and as a result the speed of walking was ranges from 96.43 to148.38 cm/sec . The average speed was 125.33±15.63721 cm/sec which was much lower than low heel shoe walk and sleeper walk. The statistically error was 2.85495 cm/sec.

Cadence

On looking the second gait parameter i.e. cadence (number of steps per minute), as like before we got different values when the girls walked with different shoe heel heights. It is noted that when girls walked with sleepers the steps / min was ranged between 63.06 to 91.61 and the mean value was 76.92±6.30437. The error was very negligible i.e. 1.15102. On other side when same group of young girls are walking with low heel sized shoes their steps / min ranged between 59.21 to 81.33, with a mean value of 70.82±36.5124 which was little lower than sleeper walk. These samples have relatively low error. On high heel walk the values are much lower. It ranges from 57.7 to 149 cm, with mean value of 63.57±36.5124, with negligible standard error of 2.92239 cm. The degree of difference among the mean values is higher than other above sited parameters.

Straid length

The third parameter to analyze is strad length. The straid length on wearing sleepers ranges from 107.33 to 166 cm, with a mean value of 140.85±15.8274 cm and standard error was calculated 2.88965, where straid length, wearing low heel ranges from 100 to 158 cm with the mean value of 132.33±14.86488, and standard error was 2.71394, which is less than sleeper walk. On high heel walk the values are much lower. It ranges from 91 to 149 cm, with mean value of 125.74±16.00661, with negligible standard error of 2.92239 cm. The degree of difference among the mean values is higher than other above sited parameters.

Number of steps in 45 meters of walk.

The last parameter was number of steps to cover 45 meter of distance by wearing different heel size shoes. The girls took 49.3 to 70 steps by wearing sleepers with an average 58.61±4.4167 steps, the standard error was 0.8172 can be consider as negligible. When they wear low heel shoes they need 55 to 76 steps to cover same distance with mean value of 64.34±5.8171, which is more than sleeper walk with an error of 1.0620. On high heel shoes girls need more steps to cover same distance, ranges from 57.7 to 78 steps with mean value of 68.75±4.9569 and standard error was 0.9050.

DISCUSSION

This study was done in Mekelle University where we selected randomly 30 young girls, age between 19 to 21 years with an aim to find out the change in selected gait parameter with respect to height of the heel, of the shoes. As a matter of lack of financial feasibility, we selected gait variable such as number of steps in fixed distance, cadence, straid length & speed of walk. To avoid the thread to
internal validity, we took 5 girls at a time for the study and we conducted 4 session of study at different time. For the study we took 45 meter distance concrete road and asked the girls to get their own shoe but the height of the heel are mentioned as sleeper with no height, low heel of 7 cm in height and high heel of 10 cm in height. More over we took three observer to collect the data of different variable and we made 3 trial to collect each variable data(s). As per the observed the four selected variables has been analysed in two different ways. In first category, it has been analysed as time dependent and time independent variables, and second category the variables are divided as per the gait parameter.

**Time independent**

In this category we took two variable, i.e. step frequency & straid length. The first observation is the range difference of each variable of gait paraments with different heel height of the shoes. The range difference (max - min), is almost similar in case of number of steps to cross 45 meter pathway, i.e- 20.3, 21, 20.7 steps for high heel shoes, low heel shoes & sleeper respectively. In straid length of walk there is no change in range difference i.e. 58.67, 58, 58 cm in sleeper, low heel shoe & high heel shoe respectively. This can be substantiated from the observed fact, the height and leg length of the girls, are almost nearby homogeneous in nature, as a result the range difference are nearly equal in case of step frequency and straid length.

**Time dependent variable**

Cadence (number of steps/min) & speed (distance / min) of walk are categorised in this variable. In this category there is better degree of observables difference rather than the above said variable. The range difference in cadence has been seen, with sleeper, it is 28.55 while as the cadence is much low i.e 22.12 & 21.25 steps/min in case of low heel shoe and high heel shoe respectively. This difference may be due to the comfort-ability in walk with sleeper because they get hold of full base surface area under the foot-sole and may took their casual speed. On the other side the heel shoes are not providing the base surface area as compare to sleeper, so the girls are cautious on walk. A different performance has been found in speed of walk, the range difference with low heel walk is highest 201.42 cm/sec followed by 84.17 cm in case of sleeper and 51.95 in case of high heel shoe walk. This observation can be explained as the selected sample is heterogeneous in walking experiences with different heel height, because few girls with urban background has an idea to walk with low heel shoe whereas for rural girls may be first time , or less experiences to walk on heel shoes.

**Gait Parameters**

Based on aim of the study when we tried to analyze on different gait parameter changes with respect to heel height of the shoes. The first parameter is speed of the gait. While walking on sleeper, low heel shoes & high heel shoes the speed was recorded as an average of 140.58 ± 15.82cm, 132.32 ± 14.86 cm, 125.74 ± 16.00cm on sleepers, low heal shoe & high heal shoe respectively. Thus we can state that shoe heal height is inversely proportion to speed, cadence & straid length. However Gefen et al [2002] study provide a strong support when his team tried to compared the effect of different heel heights on gait parameters of individuals wearing high heel shoes with low heel shoes or with bare-foot. He noted that individuals on high heeled shoes have shorter stride length but increased walking cadence.

Similarly when we analyse the third selected variable i.e. straid length it was 140.58 ± 15.82cm, 132.32 ± 14.86 cm, 125.74 ± 16.00cm on sleepers, low heal shoe & high heal shoe respectively. We can state that shoe heal height is inversely proportion to speed, cadence & straid length. However Gefen et al [2002] study provide a strong support when his team tried to compared the effect of different heel heights on gait parameters of individuals wearing high heel shoes with low heel shoes or with bare-foot. He noted that individuals on high heeled shoes have shorter stride length but increased walking cadence.

The final selected variable, i.e step frequency to cover a distance of 45 meters, when girls are walking on sleeper the number of step need to cover a certain distance, the mean value is 58 86 ±4.65 step, with sleepers, whereas the same female wearing the low heel shoe of 7 cm height the number of steps needs with average value of 64.34 ± 5.81 steps were as, high heel need 68.75 ± 4.95 steps. The similar result have been reported in the study made by Godwin et al. They revealed in their study that heel heights on gait parameter by using five female subjects and concluded that heel shoes, especially high heeled shoes, causes a decrease in stride length and step length.

The basic reason that appears responsible for variation in above studies may be due to compensation for the elevation and forward shift of the centre of gravity, and altered biomechanics of the foot so as to prevent falls and postural stability, even this cover a stronger supports by the work of Lee et al [2001]. They reported that putting on high heel shoes results in alteration of foot biomechanics, with half hearted believe the fact, that additional weight are being place on fore foot and this pushes the center of mass forward, placing more stress on the foot impact. The previous study also states that the long term high heel shoes will reduce the flexibility of the gastrosoleus muscle and as a result reduces the range of motion of ankle. Contrary to this, the study also states that the low and medium strength of gastrosoleus muscle shows the dorsi-flexed position of ankle joint, thus the dorsiflexed ankle are not able to act eccentrically, through range of motion of ankle is high, even when the knee is in flexion, but functionally the shock absorption capacity will be reduced when the knee is flexed and ankle is slight dorsiflexed, so in such case heel shoes can be beneficial in certain conditions.

**CONCLUSION**

As per the study we can conclude that the wearing sleepers, no heel shoes are much better, as compare to heel shoes. Though the young girls are using the high heel shoes as a symbol of living status or increase in height, but as per the outcome of this study says that the heel shoes alters the biomechanics of body posture and as a result the girls can’t walk in normal speed and chances of fall or walking injuries are very much high. As per our study we found that few girls are good in walking with low heel shoes, as similar to sleepers. We suspect that practice in walking with low heel shoes can alter the gate parameter, just similar to non-heel shoes. Thus in further we would like to find out, do the walking experience with different heel height shoes can alter gait parameters or not ?

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