INTRODUCTION

Besides functioning as a foot protector, shoes also have an aesthetic function. Social norms influence the choice of footwear for women. The use of high heels is considered to make the wearer look feminine.1 A study shows that high heels are still the top choice for women's footwear.4 In employment, especially in areas where direct interaction with consumers is required, female employees are required to wear high heels. A survey conducted in the United States shows that 59% of women use high heels for approximately one to eight hours daily.3

Another study included high heels as a category of bad footwear with potentially adverse effects on the wearer.7 In the UK, about 80% of women who wear high heels complain of pain in the leg muscles, and 83% feel pain in the musculoskeletal system.5 High heels affect the user’s posture, especially in the lower legs and spine. Users of high heels tend to bend their knees forward unconsciously to withstand the altered weight distribution of the body.6

A narrative from perspective biomechanical research in 2014 concluded that high heels could cause qualitatively consistent changes in gait neuromechanics and affect the kinematic and kinetic structures of the body from the toes to the spine, which can be seen in biomechanical markers of musculoskeletal conditions such as hallux valgus and osteoarthritis, which is more common in women.7,8

The likelihood of hallux valgus increases in women who wear high heels as the main shoe during the age of 20-64 years by 47% after adjusting for other factors such as gender, age, body mass index (BMI), leg pain, foot structure criteria, and history of wearing high heels. There was also an increased likelihood of hallux valgus in women who occasionally wore high heels by 24% but to a significant extent.8 The user of high heels also puts too much weight on the toes and presses them simultaneously. The long-term effects of use can cause hammertoe and abnormal bending of the toe joints leading to stiffness.10

In Indonesia, research on female salespeople in 2018 found a relationship between tenure (more than one year) and heel height of more than 5 cm with calf muscle pain in the salesperson.11 Another study noted an increase in the number of patients with injuries caused by wearing high heels, such as sprains, pain, stiffness in bone joints, and some cases of permanent damage. In addition, the use of high heels is also a risk factor for low back pain (LBP), Achilles tendon stiffness, plantar fasciitis, and Haglund deformity.12

According to the Framingham Foot Study, 29% of the 1901 women experience heel pain and pain at the bottom surface of the foot (arc pain) caused by using high-heeled shoes for more than five years. The most common pain complaints are in the lower leg, especially the plantar fasciitis.13 Several factors influence the impact

ABSTRACT

Introduction: High heels are still the top choice of women's footwear and have an aesthetic function. A previous study showed that high heels were the potential to give musculoskeletal disorders. This study aimed to find the presence of musculoskeletal disorders and the factors influencing the routine and long-term use of high heels amongst bank employees.

Methods: This is an observational study with a cross-sectional design. The research study participant collection was carried out in November - December 2020 in several Bank branches; 233 participants were obtained. Each participant was given a questionnaire about musculoskeletal disorders and the factors influencing high heels used.

Results: It was found that there is a relationship between body mass index (BMI), shoe height, and the length of time used per week for the pain Visual Analogue Scale (VAS) in the use of high heels. However, it was found that there is no relationship between the type of shoes and the pain VAS using high heels.

Conclusion: The higher BMI, shoe height, and the longer time using high heels per week contribute to the increasing pain VAS among high heel users.

Keywords: High heels, Body Mass Index, Shoe Height, Type of Shoes, Length of Time.
of using high heels, including the height of the heels, the age when first using the shoes, age of the user, length of time using the shoes, the type of shoe, anthropometry (height and weight), physical activity and sport, the degree of angle between the feet and the foothold, and the pressure when doing the foothold.3

This study aimed to determine the musculoskeletal disorders that can occur in the use of high heels regularly and for a long time to increase public and company awareness about the impact of using high heels in everyday life, including in work.

METHODS

Study Design
This study is observational with a cross-sectional design that aims to determine the presence of musculoskeletal disorders and factors that influence the routine and long-term use of high heels among bank employees.

Data Collection
The research was conducted at a state-owned and private bank in Medan from March to November 2020, with women using high heels as the targeted population. All participants must meet the inclusion criteria and not the exclusion criteria. Inclusion criteria include participants willing to participate in the research by signing informed consent, women aged 20 to 40 years, using heels with at least 3 cm, and for a minimum work duration of 40 hours per week. Exclusion criteria include no consent of participants willing to participate in the research, having a musculoskeletal disease or genetic disorders of the feet, and during pregnancy are all excluded from the experiment. Participant selection was carried out by total sampling (including all research participants) and consecutive sampling (including participants in sequence to meet the required amount). Each participant was given a questionnaire about musculoskeletal disorders and the factors influencing high heels use.

Data Analysis
The data collected will be analyzed using the Statistical Product and Service Product (SPSS) program version 22.0.

RESULTS

Total participants of 120 female bank employees agreed to participate. The results obtained are as follows; BMI included in the normal category were 103 participants (44.2%), 72 participants were overweight (30.8%), and 58 participants were obese (24.8%). It was found that most pain Visual Analogue Scale (VAS) was below 3 with 125 participants (53.6%), and there were 108 with VAS above 3 (46.4%). According to the type of shoes, 74 participants (31.8%) used wedges, 132 participants (56.7%) used stiletto shoes, and 27 participants (11.6%) used thick heels. From this data, it was found that most participants used stiletto shoes. It was found that most participants used ≤ 3 cm heels as many as 115 (49.4%), while those with heels > 3 cm were as many as 118 (50.6%). Regarding the length of high heels used, the participants who used high heels under 40 hours per week were 137 (58.8%), while those who used high heels for more than 40 hours per week were 96 (41.2%).

According to the variable of high heels and their relation to the pain VAS, the results are obtained as follows; 72 normal BMI participants with VAS of ≤ 3 and 31 participants with VAS > 3, 28 overweight BMI participants with VAS ≤ 3, and 44 participants with VAS > 3. In contrast, obese participants found 25 with VAS ≤ 3 and 33 participants with VAS > 3. Regarding types of shoes, it was found that 36 participants with VAS ≤ 3 were found in the wedges-type shoes, and 38 participants with VAS > 3. Of the participants who wore stiletto-type shoes, 69 people with VAS ≤ 3 and 63 participants with VAS > 3. While in the participant who wore thick heels, there were 20 participants with VAS ≤ 3 and 7 participants with VAS > 3. With the heel height, it was found that participants’ shoes with a heel of ≤ 3 cm were 75 participants with VAS ≤ 3 and 40 participants with VAS > 3. While in the participant who wore shoes with a heel of > 3 cm, there were 50 participants with VAS ≤ 3 and 68 participants with VAS > 3. It was found that 64 participants wore high heels for less than 40 hours each week with VAS ≤ 3 and 73 with VAS > 3. Moreover, in the participants who wore high heels over 40 hours per week, 61 participants with VAS ≤ 3 and 35 with VAS > 3.

From the data collected, we analyze using the Chi-Square method. Between BMI and pain VAS p-value = 0.000 (P<0.05) (Table 1), the types of shoes and pain VAS p-value = 0.068 (P>0.05) (Table 2), the height of the shoes and pain VAS, the value of p = 0.000 (P<0.05) was found (Table 3), and between the length of wearing shoes and VAS, the value of p = 0.011 (P<0.05) (Table 4).

DISCUSSION

Injury cases that often arise due to high heels are a pain in the calcaneus area due to plantar fasciitis and Achilles tendinitis. In addition to causing pain, using high heels can also cause changes in the ankle’s range of motion due to postural adaptations made by the body while using high heels.7,14 Therefore, footwear modification has a role in managing these orthopedic problems. Heel problems can occur because the feet are forced to be in a plantar flexion position so that the muscles and tendons in the lower extremities will work harder to compensate for this situation.14

A study in Taiwan reported a survey of shoe choices showed that 53% of women, on average, wore high heels for between 1 and 8 hours per day. Regardless of aesthetic reasons, Lee et al. surveyed 200 women who regularly wore high heels and found that 58% felt discomfort while wearing shoes.16

According to our study, it was found that there is a relationship between BMI and pain VAS using high heels. This study is in line with the research conducted by Rano et al., which found obesity to be a factor in aggravating heel pain and plantar fascia.5 It has also been suggested that foot pain and BMI can affect posture and balance due to angulation of the legs and uneven weight distribution.8 BMI is a standard measurement and can be a reference for weight loss management for patients with chronic heel pain due to being overweight. BMI is recommended not to exceed 25 (also a risk of cardiovascular disease) to reduce heel pain and respond better to the given treatment, where obesity has long been associated with foot pain.
Weight loss should be recommended as initial management in addition to orthotic devices, non-steroidal anti-inflammatory drugs (NSAID), stretching, and steroid injections. BMI can provide a better goal for a patient than only using body weight.\textsuperscript{17}

It was also found that there is no relationship between the type of shoes and the pain scale in using high heels. The most common type of shoe is the type of stiletto. In the previous study, shoes with medium and narrow heels experienced complaints of eight times more risk than those who used shoes with wide-heeled types. As the heel height increases, the pressure on the foot also increases unless the geometry of the shoe is improved. Some commercial medium and narrow rights claim the product can reduce foot discomfort, but none has been scientifically validated.\textsuperscript{8}

There is a relationship between shoe height and the pain scale in using high heels. A similar result was also found that high heels exert more power from the lower leg muscles and reduce balance when standing, especially starting at a heel height of 7 cm.\textsuperscript{18} At the same time, high heels push more force on both sides of the calf muscles (gastrocnemius medialis, gastrocnemius lateralis), anterior tibialis muscle, and vastus lateralis. Increased experience in high heels does not improve the ability to maintain overall balance. Wearers who already wear high heels frequently require less effort on most muscles.\textsuperscript{6} Thus, the height of the heel can affect gait and posture.\textsuperscript{9}

Previous research resulted in complaints of LBP wearing shoes with a heel height of ≥ 5 cm experienced a 5 times more risk than those with shoes with a heel height of <5 cm. A study found that the use of high heels more than 5 cm can affect the distribution of the load on the body and increase the activity of the

### Table 1. BMI Analysis Against VAS.

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymptotic Significance (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>19.845\textsuperscript{a}</td>
<td>2</td>
<td>.000</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>20.232</td>
<td>2</td>
<td>.000</td>
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<tr>
<td>Linear-by-Linear Association</td>
<td>13.736</td>
<td>1</td>
<td>.000</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>233</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*\textsuperscript{a} 0 cells (0.0%) have an expected count less than 5. The minimum expected count is 26.88.*

### Table 2. Types of shoes against VAS.

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
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<th>Asymptotic Significance (2-sided)</th>
</tr>
</thead>
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<td>Pearson Chi-Square</td>
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<td>.060</td>
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<tr>
<td>Linear-by-Linear Association</td>
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<td></td>
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</tbody>
</table>

*\textsuperscript{a} 0 cells (0.0%) have an expected count less than 5. The minimum expected count is 12.52.*

### Table 3. Height of heel against VAS.

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
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<th>df</th>
<th>Asymptotic Significance (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
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<td>.001</td>
<td>.000</td>
</tr>
<tr>
<td>Continuity Correction</td>
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<tr>
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<tr>
<td>Fisher's Exact Test</td>
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<td></td>
<td></td>
<td>.001</td>
<td>.000</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
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<td>1</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N of Valid Cases</td>
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</tbody>
</table>

*\textsuperscript{a} 0 cells (0.0%) have an expected count less than 5. The minimum expected count is 53.30.*

*\textsuperscript{b} Computed only for a 2x2 table*

### Table 4. Length time of heel use against VAS.

<table>
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<th>Chi-Square Tests</th>
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<th>df</th>
<th>Asymptotic Significance (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
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<tbody>
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<td>Fisher's Exact Test</td>
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<td>.008</td>
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<tr>
<td>Linear-by-Linear Association</td>
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<td>1</td>
<td>.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N of Valid Cases</td>
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<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*\textsuperscript{a} 0 cells (0.0%) have an expected count less than 5. The minimum expected count is 44.50.*

*\textsuperscript{b} Computed only for a 2x2 table*
paraspinal muscles associated with various musculoskeletal diseases, one of which is LBP. This study concluded that there is a relationship between the length of time using high heels per week and the pain scale in the use of high heels. No similar studies examined the relationship between weekly high heel wear and wearer pain scale duration. Moreover, a prior study found a relationship between the length of service of the sales assistant wearing high heels and complaints of LBP. Most sales assistants aged between 20-25 years with normal nutritional status and heels of 5-7 cm for more than one year. About 68% complained of LBP and 11% of the subjects had a suspicion of disability due to complaints of LBP. The height of the heels is not related to LBP complaints, but the clerk’s tenure is associated with complaints of LBP.

CONCLUSION

This research concludes that a higher BMI of overweight and obese, more than 3 cm of high heels height, and the longer a person’s time using high heels per week all contribute to the fact that it increases the discomfort and pain while using high heels. However, this association is not found between the types of shoes and their pain effect on its user. A larger number of participants with a wider population in this research could improve the relationship between variables.

DISCLOSURE

Author Contribution

All authors have contributed to this research process, including conception and design, analysis and interpretation of the data, drafting of the article, critical revision of the article for important intellectual content, final approval of the article, collection and assembly of data.

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Conflict of Interest

There is no conflict of interest for this manuscript.

Ethical Consideration

This research was approved by the Health Research Ethics Committee of Medical School Universitas Sumatera Utara/ General Hospital Adam Malik. Letter of exemption Ref. No. 931/USU/LL/2020

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REFERENCES