



## Factors Contributing to Plantar Fasciitis in Women

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### ABSTRACT

**Introduction:** Plantar fasciitis is a degenerative syndrome that causes inflammation of the plantar fascia due to repetitive trauma and excessive stretching, which can cause a tear in the plantar fascia. This study aimed to determine the possible risk factors that affect the incidence of plantar fasciitis.

**Methods:** This study design was the literature review. This study searched journals through Google Scholar and PubMed databases related to plantar fasciitis or the factors that influence plantar fasciitis.

**Results:** In general, the risk factors for plantar fasciitis are classified into intrinsic and extrinsic factors. Inherent factors can be age, gender, and body mass index (BMI), while outside factors are the use of shoes and duration or standing time.

**Conclusions:** A high BMI is a more dominant intrinsic factor in causing plantar fasciitis. Meanwhile, the use of shoes and the duration of time of standing were the more dominant external factors for the incidence of plantar fasciitis.

**Keywords:** foot and ankle, plantar fasciitis, risk factors, women.

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### INTRODUCTION

People work hard for their needs and make humans more active in this competitive world.<sup>1</sup> Million workers spend most of their working time in a standing position.<sup>2</sup> A study states that workers who work in a standing position have moderate-intensity leg pain complaints with 71.4% and a total of 28.6% for high-intensity leg pain. The leg pain might represent a severe biomechanical and tissue problem that must be overcome immediately. Currently, the most body parts of workers that often experienced pain in Indonesia were the legs, waist, and shoulders with 22.7%, 17.1%, and 9.5%, respectively.<sup>3</sup>

Workers try to keep their bodies balanced when working standing up. Standing in an upright position for long periods can be the cause of causing the feet and lower legs to feel uncomfortable or painful, which can lead to other health complaints. This complaint often occurs in employees or workers with jobs requiring quite a long time, about 8-12 hours every day.<sup>4</sup> Working positions standing stagnant or walking for a long time will cause discomfort and a static workload in the leg area, which is the cause of the leg muscles experiencing a workload that will cause complaints in the heel area and soles of the feet. Therefore, the two parts of the body are prone to impaired function and movement.

Plantar fasciitis is the most common complaint.

Heel pain (plantar fasciitis) is a common condition that occurs in all ages of people with various levels of activity.<sup>5</sup> The syndrome that causes heel pain is related to inflammation or irritation in the plantar fascia area.<sup>5</sup> The plantar fascia is a connective tissue with an arch-like shape, is located in the lower leg, originates on the calcaneus, and inserts on the heads of the first to fourth metatarsals of the toes.<sup>6</sup> It is estimated that plantar fasciitis affects people's lives significantly by 10%, whereas the peak of plantar fasciitis is estimated at the age between 40-65 years. The results of reports from some researchers state that an athlete's feet and non-athletics suffer from plantar fasciitis by 8-15%.<sup>7</sup>

The prevalence of plantar fasciitis is 8-15% in ankle and foot injuries.<sup>8</sup> Information from the National Health and Wellness Survey in 2013 stated that the prevalence of plantar fasciitis was more experienced by women compared to the majority of men; in the age range of 45-64 years, 1.19% of complaints of plantar fasciitis were experienced by women and by 0.47% in men.<sup>9</sup> A survey in the United States said for a case of plantar fasciitis in every human being with an average age of 40-60 years, about two million people received a follow-up on this case.<sup>8</sup>

Plantar fasciitis is a pain in the heel area characterised by a stabbing feeling in the foot that can cause pain. This usually occurs in the morning when the first time will step on the foot or walk,

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but the feeling will disappear little by little when walking.<sup>9</sup> However, this pain can reappear when standing for an extended period or getting up when previously in a sitting position.<sup>9</sup> Globally, the incidence of plantar fasciitis is the cause of 10% of the American population experiencing heel pain. This is experienced by 40% of workers who stand up while working for more than 6 hours, 70% of people who are overweight or obese, and 30% of people over 50 years old.<sup>10</sup>

Several factors can cause plantar fasciitis. These factors are internal and external. Intrinsic factors can be in the form of body mass index (BMI), gender, and age which causes a degenerative process that decreases the flexibility of the plantar fascia. Extrinsic factors are the use of shoes and the duration of standing time. When held for an extended period, this position will cause the plantar fascia to experience excessive or unnecessary traction and then trigger inflammation and irritation of the plantar fascia.<sup>11</sup> Because of the tear from the result. Plantar fasciitis impacts daily activities, such as reducing movement, efficiency, and endurance, affecting productivity at work and activities. Based on the explanation above, the authors are curious to investigate various factors that can cause plantar fasciitis in women.

## METHODS

This study uses a literature review study method. The literature review was conducted on journals accessed through Google Scholar and PubMed journal databases from the year 2010 to the year 2020. A literature search was a journal of reviewed research relating to plantar fasciitis or the factors influencing plantar fasciitis, such as foot and ankle.

## RESULTS

In this literature, there are several research results on plantar fasciitis described. There are six research titles with different methods and variables. Research conducted by Robert A. Werner in 2010 showed the risk factors for plantar fasciitis in automotive engine assembly plant workers in the northern United States.<sup>12</sup> Four hundred and seven employees (61%) were recruited into this study through brochures posted around the factory, factory bulletin articles, 3-minute recruitment videos that were shown occasionally on internal television machines, and team meetings. Participation includes filling out a symptom questionnaire, a physical examination, and an occupational exposure assessment based on a job analysis that focuses on posture or lower body parts. The results obtained from the study said that plantar fasciitis is relatively common in the elderly

between 40-60 years. An increased risk of plantar fasciitis is associated with forefoot pronation, an increased time spent working standing on a hard surface, and spending time working walking. The inventors suggest several options for strategies to prevent plantar fasciitis, one of which is orthosis shoes. Work stations can reduce walking or standing presentations by allowing workers to alternate between sitting and standing postures, thereby reducing the risk of plantar fasciitis.<sup>13</sup>

Merta et al., 2018 conducted a study using cross-sectional analytic research methods and purposive techniques to take samples. The sample will be divided into three groups which will consist of 25 people. People with an average BMI of 18.5-22.9 kg/m<sup>2</sup> were put into group A, for group B filled of people who had an excess Body Mass Index or were overweight, namely 23-24.9 kg/m<sup>2</sup>, the last one was people with Body Mass Index Obesity or someone who has a Body Mass Index of more than 25 kg/m<sup>2</sup> was put into group C. This study was conducted to determine whether there is an effect of the comparison of Body Mass Index on the incidence of plantar fasciitis. The research conducted shows that there is a different level of risk for people with plantar fasciitis, 4% for average Body Mass Index. 10.7% for those with excess Body Mass Index weight and 16% for the obesity category. Women who have an extra Body Mass Index or obesity are prone to a higher risk, 3.34 times higher, for plantar fasciitis. When compared with women who have an average Body Mass Index.<sup>14</sup>

Andini 2019 conducted a literature study. From his research, a result is described, which BMI influences human health. Therefore, someone must have an ideal Body Mass Index to support health. Obesity has a vital role as a risk factor for plantar fasciitis.<sup>15</sup> van Leeuwen et al. conducted a study using a prospective, case-control and cross-sectional, 2105 adults suffered from plantar fasciitis, and the control group (healthy) was used as a sample. From the research that has been done, the results show that there is a relationship between Body Mass Index (BMI) and plantar fasciitis (95% CI 2.93 - 5.62).<sup>16</sup>

Sugiharti and colleagues conducted a study to determine whether there was a relationship between the use of high heels on the intensity of pain in the calcaneus area that can cause changes in the range of motion in the ankle. The research method used the analytical survey method with a cross-sectional search design. This study shows a correlation between someone who uses high heels and the incidence of pain in the calcaneus, obtaining a p value > 0.05 in the correlation with the use of heels.<sup>17</sup>

Khodair and Younes 2019 also conducted a study on the effect of using high heels on plantar fasciitis as Sugiharti did. The study was conducted on 40 patients who wore high heels and suffered from plantar fasciitis and 20 people as a control group. Researchers looked for a relationship between plantar fasciitis due to the use of high heels or better known as high heels, getting MRI results to help diagnose plantar fasciitis in the feet. Research shows that women who often wear high heels are prone to plantar fasciitis.<sup>18</sup>

## DISCUSSION

The heels and soles of the feet are body parts that receive all the pressure when we stand or move. This can cause the soles of the feet and heels to experience movement and function disorders, one of which is plantar fasciitis. Plantar fasciitis is one of the most common ankle and foot conditions caused by repeated trauma and overstretching that resulting inflammation.<sup>11</sup>

The plantar fascia is the connective tissue on the sole that attaches from the calcaneus to the toes.<sup>19</sup> American academy of orthopaedic surgeons plantar fascia says plantar fascia is a long and thin ligament that lies directly under the sole of the protects the heel to the forefoot and forms an arch. Anatomically, the plantar fascia consists of three parts, namely medial, lateral, and central. Plantar fascia functions as a support for the longitudinal arch of the foot when standing still and plays a vital role in maintaining the turn of the foot. When standing or walking, the sole will touch the ground and accept the body's weight, which causes the plantar fascia to lengthen or stretch. However, when sitting or lifting one leg while stepping, the foot will neither touch the ground nor accept the load, so the plantar fascia will return to its initial shape or state before stretching.

Plantar fasciitis is caused by inflammation at the attachment of aponeurosis located on the anteromedial tuberosity calcaneus and posterior to the calcaneus. So that the pain of plantar fasciitis is often felt in the anteromedial part of the calcaneus tuberosity and sometimes in the rear part of the calcaneus pathophysiology of plantar fasciitis begins with stress and causes excessive stretching of the plantar fascia. The factors that cause it are the lack of flexibility of the plantar fascia and the tightness of the gastroc or soleus muscles.<sup>20</sup> When the plantar fascia is stretched excessively, the distance between the collagen fibres will decrease and cause the elasticity of the collagen network to decrease, which can cause tearing in the plantar fascia can cause inflammation. Inflammation will cause pain

when doing activities such as walking, running, and standing for a long time.<sup>21</sup> Inflammation of the plantar fascia can also cause muscle stiffness to compensate for pain. Weakness in the muscles can cause instability, leading to strains or sprains. If the inflammation is allowed to occur for a long time, it can result in decreased flexibility in the ankle and sometimes result in the formation of osteophytes in the medial calcaneus.<sup>20</sup>

Clinical diagnosis is an important thing that must be done so that plantar fasciitis can be identified as early as possible.<sup>22</sup> When a patient comes for a consultation, medical personnel will take a history obtained from information and complaints experienced by the patient and physical tests. Patients with plantar fasciitis will complain of pain in the anteromedial tuberosity calcaneus and posterior to the calcaneus. The pain felt by patient will feel more pain when stepping on the foot after waking up in the morning and the first time the sole is tread after resting for a long period. Physical tests that can be done are dorsiflexion of the ankle. The patient is plantar fasciitis has limitations in dorsiflexing the ankle, and the pain will increase in when toes.<sup>23</sup> After that, to confirm the diagnosis, an MRI (Magnetic Resonance Imaging) is done to verify plantar fasciitis or see if there is a possibility of plantar fascia rupture.<sup>24</sup> Investigations can certainly help see if there are other cases such as heel spurs.<sup>25</sup>

The factors that can cause plantar fasciitis are grouped into two, namely internal and external factors. Intrinsic factors are causative factors originating from within the body.<sup>26</sup> While extrinsic factors are causative factors arising from outside the body. Intrinsic factors include age, BMI, and gender. Age is an inherent factor that causes degeneration, whereas plantar fasciitis is most at risk of occurring at 40-60 years. BMI in people who are obese or overweight will make the plantar fascia receive more significant pressure than those who have an average Body Mass Index.<sup>27</sup> Against Gender also affects the risk of developing plantar fasciitis, with women having more substantial trouble. Other intrinsic factors that can affect the risk of plantar fasciitis are the foot's shape (related to the foot's arch), and ankle limited plantar flexor.

People in long-standing positions or walking long distances for a long time cause the plantar fascia to stretch for a long time (overuse). Excessive loading due to physical activity affects the risk of plantar fasciitis. Using inappropriate shoes or walking barefoot, especially on hard surfaces, will increase the risk factor for suffering from plantar fasciitis. In addition, plantar fasciitis can also be influenced by the profession one is in one of which is SPG.

Age is one of the intrinsic factors that can cause plantar fasciitis. Research conducted by Werner et al. 2010 shows that plantar fasciitis can occur in the elderly between 40 and 60 years.<sup>12</sup> Meanwhile, according to Scher et al. 2010, plantar fasciitis is most common in adults who work actively between 25-65 years.<sup>13</sup> It can occur in people of any age and generally in young adults in a standing working position. Age is one of the factors that aggravate the occurrence of plantar fasciitis. As you get older, it will be easier for body fat to accumulate due to a decrease in muscle mass. In addition, increasing age will cause a reduction in estrogen levels which can affect fat distribution. The need for calories needed by the body will be low due to a reduction in the body's metabolic ability. It will burn fewer calories to allow for obesity, where obesity is one of the factors that can cause plantar fasciitis. Increasing age will also cause degenerative processes that will impact decreasing tissue function, one of which is a decrease in the plantar fascia.<sup>14</sup>

BMI indicates that the body is in a good and healthy body proportion. WHO classified BMI into three groups, namely underweight with a BMI of 18.5 kg/m<sup>2</sup>, normal with a BMI of 18.5 - 24.9 kg/m<sup>2</sup>, and obese with a BMI of 30 kg/m<sup>2</sup>. Obesity is the accumulation of fat in the body in excess and results in weight gain. Research conducted by Redina Andini found that BMI affects human health, so a person is required to have an ideal BMI to support health. Obesity plays an important role as a risk factor for plantar fasciitis.<sup>15</sup> Every year, the prevalence of obesity is increasing and is more common in women. This is because women's metabolism is lower than men's, resulting in high levels of fat in women's bodies. The decrease in estrogen levels with increasing age in women also affects fat distribution.<sup>14</sup> Obesity with a BMI of 30 kg/m<sup>2</sup> is said to be a risk factor for musculoskeletal disorders, one of which is plantar fasciitis.<sup>15</sup> According to research conducted by Merta, et al. With a sample of 75 adult women in Gianyar, it was found that obese people have a 3.34 times greater risk of suffering from plantar fasciitis compared to people who have a normal BMI.<sup>14</sup> This is also in line with research conducted by Leeuwen, et al, this study used a sample of 2105 consisting of plantar fasciitis and healthy people without plantar fasciitis, it is said that there is a relationship between BMI and plantar fasciitis. The increase in BMI is proportional to the increased risk of fasciitis, where a high BMI causes the pressure received by plantar fascia to increase to the plantar. A high BMI value causes the weight that must be received by the feet to increase, especially on the calcaneus. The increase in BMI also causes an increase in the

load to be received by the gastrocnemius and soleus muscles. This causes stiffness in the muscle so that the ability of the muscle to stretch is reduced and will cause a decrease in ankle dorsiflexion ROM. dorsiflexion ROM ankle will cause compensation by the subtalar which moves towards pronation increasing pressure on the plantar fascia.

As a supporter of human activities, Footwear has a function for health and beauty. Footwear as a health function is to maintain cleanliness and protect the feet, while it can increase beauty in appearance in terms of beauty.<sup>28</sup> Various kinds of high heels are collected by women, ranging from shoes that have heels as high as 5 cm to 17 cm. Apart from the beauty of the footwear, footwear with heels height of more than 5 cm has a reasonably high health risk.<sup>28</sup> According to research conducted by Khodair and Younes 2019, it occurs in women who wear high heels shoes.<sup>18</sup> This study used a sample of 40 people who suffered from plantar fasciitis due to high heels of more than 2.5 inches with an average duration of 4 hours/day or within five days/week, with an average Body Mass Index of 25-30%. There is also a control group (not suffering from plantar fasciitis) with as many as 20 people who do not wear high heels and do not have complaints of pain in the heels. Women who use high heels often complain of pain in the heel because when walking, the part of the shoe that sticks to the heel will touch the ground first, and then the toes will follow. A common cause of plantar fasciitis is pain that arises due to biomechanical changes in the foot, where the foot will support a heavier load or pressure for a long time. Contractions continuously. Research conducted by Sugiharti et al. 2017, the relationship between high heels and the intensity of pain in the lower limbs, precisely in the calcaneus, the medial and posterior significant effect on pain intensity due to using high heels.<sup>17</sup> When using high heels for a long time can cause pain due to increased activity carried out by the Achilles. Tendon Achilles serves as a place of attachment for the insertion of the gastrocnemius and serves as a link between the gastrocnemius and the calcaneus. Tendon Achilles is the largest tendon that attaches to the lower leg. The use of high heels can cause pain in the calcaneus due to increased stress on the plantar fascia and tendon Achilles, the greater the possibility of tissue damage and inflammation. Other factors that may trigger the occurrence of pain in the calcaneus include; shoe material quality.<sup>17</sup>

## CONCLUSIONS

Based on the literature review, it can be concluded that plantar fasciitis is one of the most common

foot and ankle diseases. Plantar fasciitis occurs because of the factors that influence plantar fasciitis, starting from the intrinsic factors, namely age, BMI, and gender, which affect the incidence of plantar fasciitis. BMI is a risk factor that has a more significant influence on the incidence of plantar fasciitis. A BMI of 30 kg/m<sup>2</sup> or obesity has a high risk of plantar fasciitis, 70%. Extrinsic factors are the use of shoes and the duration of standing time. Using footwear with a height above 5 cm or 2.5 inches can cause plantar fasciitis complaints while standing or walking for extended periods can cause overuse and direct trauma that can attack the plantar fascia, which can cause tissue damage and inflammation can cause a painful reaction.

### CONFLICT OF INTEREST

No conflict interest in this study.

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### AUTHOR CONTRIBUTIONS

IGADR conceived the study design and data collection and drafted the manuscript; PASS and AANTND collected the data and revised the manuscript.

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