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## The Affects of the Foot Conditions on the Homeless Population

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THE AFFECTS OF THE FOOT CONDITIONS ON THE HOMELESS  
POPULATION

by

ALEX KAYE

A thesis submitted in partial fulfillment of the requirements for the Honors in the Major  
Program in Biomedical Sciences in the College of Medicine and in the Burnett Honors  
College  
at the University of Central Florida  
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Thesis Chair: Camilla Ambivero Ph.D.

## Abstract

The research is attempting to acknowledge and explain the impact, if any, on homeless individuals not wearing socks. The curiosity for this study started on December 25th, 2018 when my family and I were volunteering at a homeless shelter in South Florida. After having numerous conversations with homeless individuals, I was informed on how they do not have enough pairs of socks to keep their feet in a healthy condition. Thus, I decided to initiate a sock drive to improve the lives of those who are homeless. This study is looking at a series of articles that are reviewing the different foot issues amongst the homeless community but are looking to see if socks play a role in the feet developing any foot diseases. *It was hypothesized that homeless individuals will be at greater risk for foot disease if they live outside and have improper footwear.* The objective of the study sought to review the current literature on the lack of socks for those who are homeless. Between the United States and Canada, it is estimated that nearly 700,000 individuals are homeless in a 2016 report. Of the 700,000 there are roughly two-thirds of this population that have some type of disease with their foot (To and Brothers, 2017).

Majority of people who perform a good deed, such as give away old clothes or shoes, very seldomly donate socks according to the company Bombas socks. Throughout the course of my time volunteering, I have witnessed several homeless individuals wear shoes but not socks. Due to uncomfortableness, the individuals remove their shoes and it is very eye opening to observe their feet. Homeless shall be defined as “having no home or permanent place of residence” as per the Merriam-Webster's dictionary.

The study was reported based on guidelines recommended by the Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA) of 125 studies related to

homelessness and foot diseases and disorders. Literature searches were carried out on PubMed, Google Scholar, and ScienceDirect. With an evidentiary table, the characteristics of the studies included in the meta-analysis (n = 100 studies) are presented. This analysis suggests that not wearing the appropriate foot protection (shoes and/or socks) leads to an increase in foot diseases and disorders among the homeless.

## **ACKNOWLEDGEMENTS**

I would like to say thank you to my thesis chair, Dr. Ambivero, for all her help during this journey. To Dr. Hawthorne and Dr. Malaret, thank you for being on my committee. I would also like to thank my late mother for always being so supportive of me. Thank you.

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## **Chapter One: Introduction**

### **Foot Conditions**

For several years, when people have donated to charity, they bring their old clothes or shoes that they do not use anymore. Unfortunately, socks are not a common donation according to the Journal of Primary Care and Community Health. One would think it is probably not comfortable to wear a pair of shoes without socks, but those who are homeless still attempt to do it. Foot problems are common among homeless persons, but often overlooked. Foot problems are a major cause of illness and may represent up to 20% of the medical complaints of homeless people. Common foot-related concerns include corns and calluses, nail pathologies, and infections. Foot pathologies related to chronic diseases such as diabetes were also identified. Compared to house individuals across studies, homeless individuals were more likely to have foot problems including tinea pedis, foot pain, functional limitations with walking, and improperly-fitting shoes (To, Brothers, Van Zoost, 2016). These conditions make walking unbearable for those that are homeless, which creates a problem as those homeless have to walk everywhere. Walking is a common mode of transportation among homeless individuals and increased risks of physical injury, poor hygiene, and inadequate footwear have been cited as contributing factors to the development of foot problems (To, Brothers, Van Zoost, 2016). Standing for long periods and sitting, a position often used for sleeping, results in venous stasis and leg oedema sometimes associated with ulcers (Didier, Foucaulta, Brouqui, 2001). With limited access to health care, the foot problems only become worse. Lack of hygiene, such as unwashed socks worn for weeks or months, and overgrown toenails also promote the development of foot lesions with maceration contributing to the formation of ulcers (Didier,

Foucault, Brouqui, 2001). Poorly fitting shoes may precipitate in-grown toenails and diabetic foot syndrome. Increased plantar pressure, especially beneath the metatarsal heads, and the resultant callus also play an important role in causing diabetic foot syndrome (Aboud, 2012). Lack of access to health services and financial resources also prevent homeless individuals from receiving appropriate treatment for foot-related concerns early on (To, Brothers, Van Zoost, 2016). Treatment of homeless people is complicated by financial constraints, self-neglect, and lack of adherence. Nails and toes are frequently infected with dermatophyte fungi causing tinea pedis, and onychomycosis. The combination of trauma, stasis, and ischemia in the feet promotes infections, particularly streptococcal cellulites. Foot ulcers can be infected by a mixed bacterial population including *Staphylococcus aureus*, anaerobes, and enterobacteria, which may result in osteomyelitis, cellulitis, and as well as gangrene and necessitate amputation of the limb (Raoult, Foucault, Brouqui, 2001). Tetanus may also occur, therefore, routine vaccination against this disease is advised. Prevention of foot lesions is based on promoting hygiene, providing appropriate footwear, and the early treatment of lesions (Raoult, Foucault, Brouqui, 2001). The treatment for osteomyelitis, cellulitis, and foot ulcers is best achieved in hospital, therefore, this trend will continue to occur as homeless people cannot afford the price of a hospital as 60% have no insurance, though many are eligible for Medicare or Medicaid due to their age or disability status. A common reason as to why individuals will not have health insurance is due to lack of knowledge about where to get treated, lack of access to transportation, and lack of identification (Whitbeck, 2009). Medicaid patients are known to have reduced access to care compared with privately insured patients and experience increased barriers to care compared with privately insured patients (Hsiang, Lukasiewicz, Gentry, Kim, Leslie, Pelker, Forman, Wiznia, 2019).

## **Foot conditions: External Factors**

As defined by Merriam-Webster's dictionary, homeless is defined as "having no home or permanent place of residence," therefore, when living outside, the weather becomes a significant health factor. Hypothermia, frostbite, and nonfreezing cold injuries predominantly affect older adults, the homeless, intoxicated people, adventurers, and military personnel (Rathjen, Shahbodaghi, Brown, 2019). The high prevalence of hypertension and heavy tobacco use in homeless people commonly causes arteriosclerosis, which can lead to ischemia of the lower limbs (Didier, Foucaulta, Brouqui, 2001). Hypothermia is a medical emergency that occurs when your body loses heat faster than it can produce heat, causing core body temperature to be below 95°F (Rathjen, Shahbodaghi, Brown, 2019). Frostbite is an injury caused by freezing of the skin and underlying tissues and it usually affects the extremities (Rathjen, Shahbodaghi, Brown, 2019). Immersion foot occurs during damp nonfreezing conditions and it is being seen with increasing frequency among the homeless population (Wrenn, 1991). It represents the effects of injury by water absorption in the stratum corneum of the skin of the feet. This syndrome may be exacerbated by disturbances of cognition, peripheral neuropathy, peripheral vascular disease, or the use of tobacco or vasoconstrictor drugs such as cocaine. Attention to foot care problems among the homeless and education concerning preventive measures are incumbent on physicians who care for the indigent (Wrenn, 1991).

A major contributing factor seems to be the lack of shelter in the homeless population (Wrenn, 1991). The homeless population is suffering due to the lack of beds in the shelters so it leads to more homeless individuals having their feet suffer from walking outside more often (Wrenn, 1991). Homeless individuals not wearing closed toe shoes are more likely to contract

deep fungal infections, including Madura foot (also known as mycetoma) which might result from injury of unprotected feet by a thorn or plant elements. Cutaneous larva migrans is a skin disease that manifests as an erythematous, serpiginous, pruritic, cutaneous eruption (Aboud, 2012). This disease is caused by accidental percutaneous penetration and subsequent migration of larvae of various nematode parasites. In addition, foot care upon removing the shoes consist of washing then drying the foot and using moisturizers, which will overcome the problems of humidity that result from using closed shoes for a long time. The inside of shoes can be sanitized with germicidal shoe trees or other cleansing methods to prevent the growth of microorganisms, such as odor-causing bacteria or fungi (Aboud, 2012).

### **Foot conditions: Internal Factors**

Gender and age play a significant role in how much damage bacterial and fungal infections can affect those of the homeless population. Females are different from males in both structure and biomechanics. Female's feet tend to have a narrower heel in relationship to the forefoot and overall is narrower than a man's foot, relative to length. Females tend to pronate their feet more and have a smaller Achilles tendon than males, both factors having implications to shoe fitting. Although shoes have been worn for thousands of years for the main purpose of protecting feet from the environment, recent studies have implicated shoes as the principal cause of forefoot disorders seen in females. Several authors have reported the harmful effects of footwear and the greatest factor is a shoe that is improperly fit after review of articles Matthew, J., Brothers, T., Zoost (2016).

Children's feet are different to adult feet, both in shape and posture, and are constantly changing as the child grows. In addition, the morphology of children's feet is more malleable

than adult feet. Indeed, footwear has been used to correct pathological skeletal alignment and foot posture among children for many years, therefore, correct shoe fitting in children is of paramount importance (Buldt, Menz, 2018). Shoes are specific to different feet and functions, where shoes that are used for hiking are different than those used for running. Failure to select the optimal shoes for a given place or function might subject the feet to injury (Aboud, 2012).

## **Chapter Two: Purpose**

The objective of this particular study is to gain a better understanding about how homeless individuals have serious health concerns with their feet due to lack of available resources. Throughout this study conducted, there was a rise in the homeless population due to the ongoing COVID-19 pandemic. Upon the start of COVID-19, it led to people being evicted from their homes as there was an increase to a historic level of unemployment (Koziel, Savidov, Frick, 2021). Therefore, there are new individuals each and every day that are suffering from the negative effects of being homeless. The goal of the study is to bring awareness to what the homeless population has to endure on a regular basis, specifically with their feet.

## **Chapter Three: Methods And Procedure**

### *Overview*

The use of scholarly peer-reviewed journal articles allowed for the conducting of this review. The University of Central Florida's database was used with search filters to personalize the articles towards the field of homeless, foot disease and socks. Database included Google Scholar, PubMed and ScienceDirect with articles published from 2016 to 2022. The review was guided by methodology outlined by the PRISMA 2020 statement guidelines ([http://www.prisma-statement.org/documents/PRISMA\\_2020\\_checklist.pdf](http://www.prisma-statement.org/documents/PRISMA_2020_checklist.pdf)). Databases were last accessed in April 2022. Databases were last accessed in April 2022.

### *Eligibility Criteria*

- Studies that were included in this analysis were performed in the United States and Canada only.
- The search had several terms to search for articles in the three databases (Table 1) – PubMed (2016-2022), Google Scholar (2016-2022) and ScienceDirect (2016-2022) – and were used in different combinations. Articles that discussed foot disease but not socks were included to give an overview of the importance of foot disease in the homeless.

### *Search Strategy*

The terms that were used in the process to discover a various range of articles that had disclosed information on reported foot issues/diseases in the homeless populations around the world are listed in Table 1. These terms were used in different combinations with OR and AND. Only those articles that met the criteria were included.

<i>Search terms used in Google Scholar, PubMed and ScienceDirect for articles related to homelessness and foot disease</i>		
“Homeless Persons”	“Vulnerable Populations”	“Onychomycosis”
“Homeless Youth”	Homeless Vulnerable	onychomycos
homeless*	socks	Diabetic Feet / foot
shelter seeking	lack of socks	“Tinea Pedis”
seeking shelter	“Podiatry”	Athlete’s foot

**Table 1: Search Terms Entered into Google Scholar, PubMed, and ScienceDirect for Homelessness and Foot Disease Related Articles**

### *Selection Process*

Articles were initially screened through their abstracts. If it was unclear if the article met the inclusion criteria, the full article was accessed to determine eligibility. Only articles that met the inclusion criteria were included in the meta-analysis. This led to a total of 25 articles used in the meta-analysis.

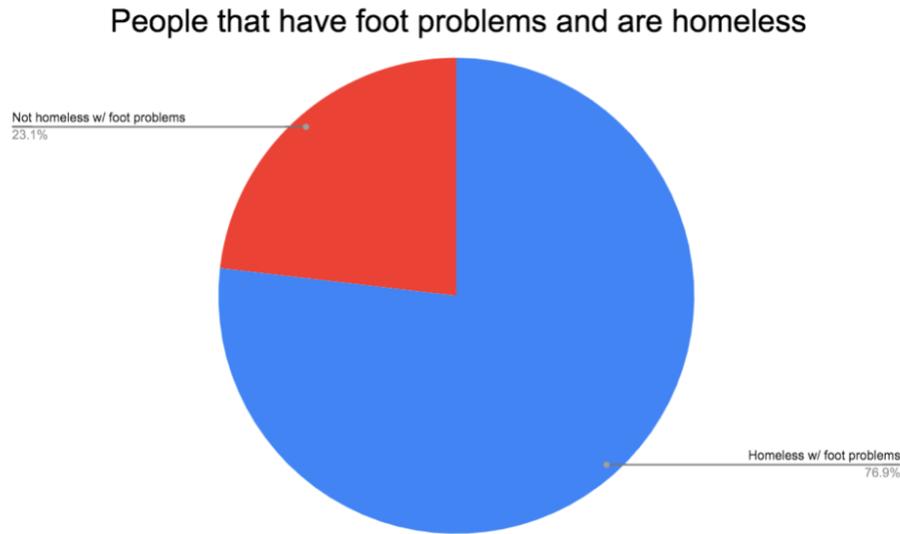
### *Data Analysis*

The data was collected from the selected studies that fit the criteria to help answer the question if the homeless population is more likely to have feet problem due to inappropriately wearing shoes and/or socks. A data table was created with the following variables: general study

characteristics (author, date of publication, country of study), participants (age, sex, sociodemographic), study design, foot assessment method, foot conditions, and summary of study findings. This table provided a means of assessing the reliability of the included papers according to the parameters chosen.

The objective of the study is to understand how homeless individuals in North America who do not wear proper foot protection (shoes and/or socks) are more prone to infections and potential amputations of their foot or feet.

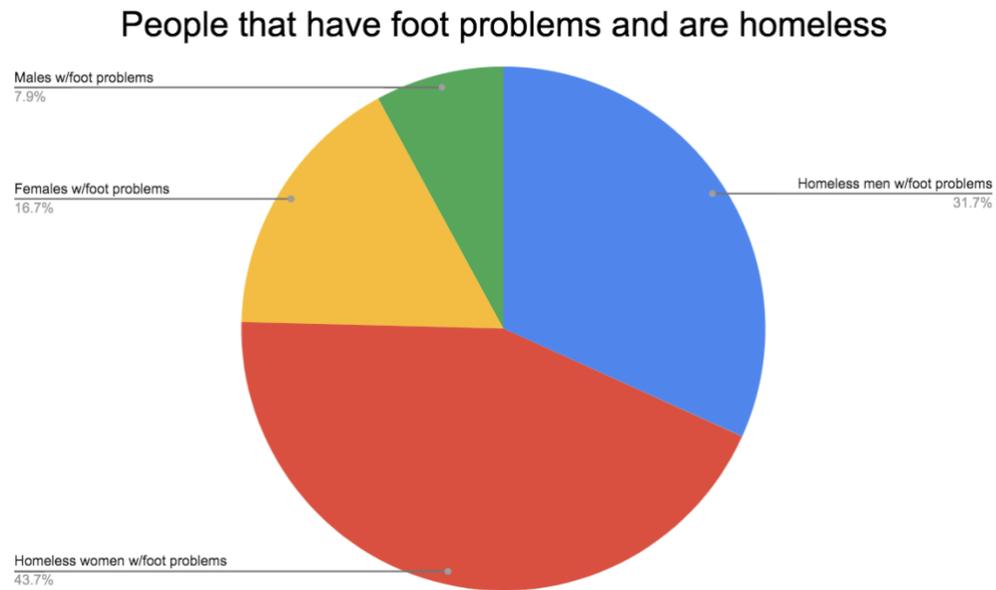
## Chapter Four: Figures



**Figure 1: Pie chart displaying the amount of people who have foot problems and the amount who are homeless with foot problems**

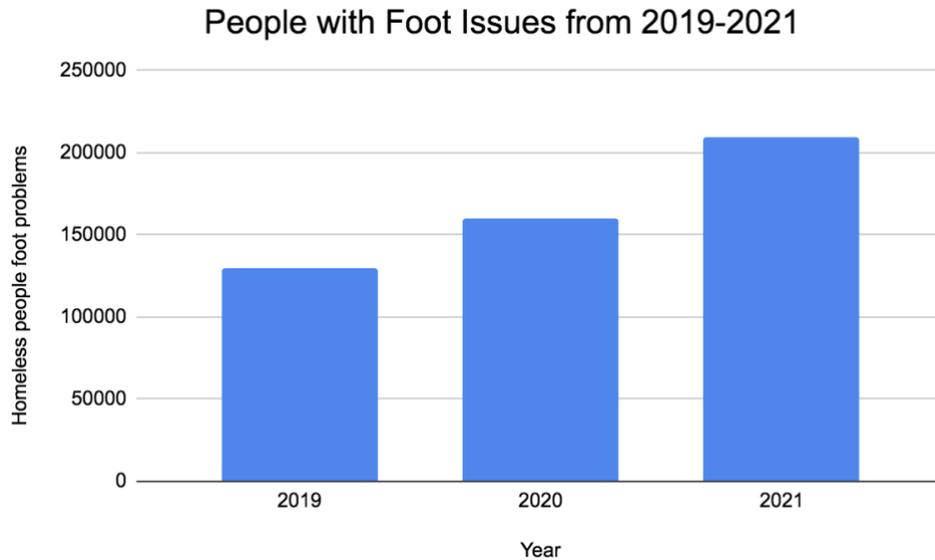
This figure displays a pie chart with the number of people who are homeless with foot problems versus the amount of people who are not homeless with foot issues. There is roughly just over three times more individuals who are homeless than non-homeless that have foot issues. The 76.9% factors in those who are homeless that live outside and those who are homeless and live inside. After completing a t-test for this graph, it has a p-value that is 1.96E-2. Thus, since this value is less than 0.05, it will fail to reject the null hypothesis. Unfortunately, this

means that our sample is not large enough with only using 25 relevant articles. However, it is fair to assume that the trends are relatively true.



**Figure 2: Pie chart displaying the amount of people who have foot problems and the amount who are homeless with foot problems in comparison to gender**

This figure is depicting how gender plays a key role in determining who is more vulnerable to obtaining a foot disease. As seen in the graph, women statistically will obtain foot problems at a greater rate than men regardless of being homeless or not. There are more homeless women with foot issues than a non-homeless women by a significant amount. However, the non-homeless women do not have that much more foot issues than males who are not homeless. It is very rare for non-homeless individuals to have a long-term foot disease because they are more likely to have it checked out by the doctor in the beginning phases of when there is an issue. On the other hand, a homeless person does not have the same access to healthcare professionals so the foot issue will worsen over a gradual period of time.



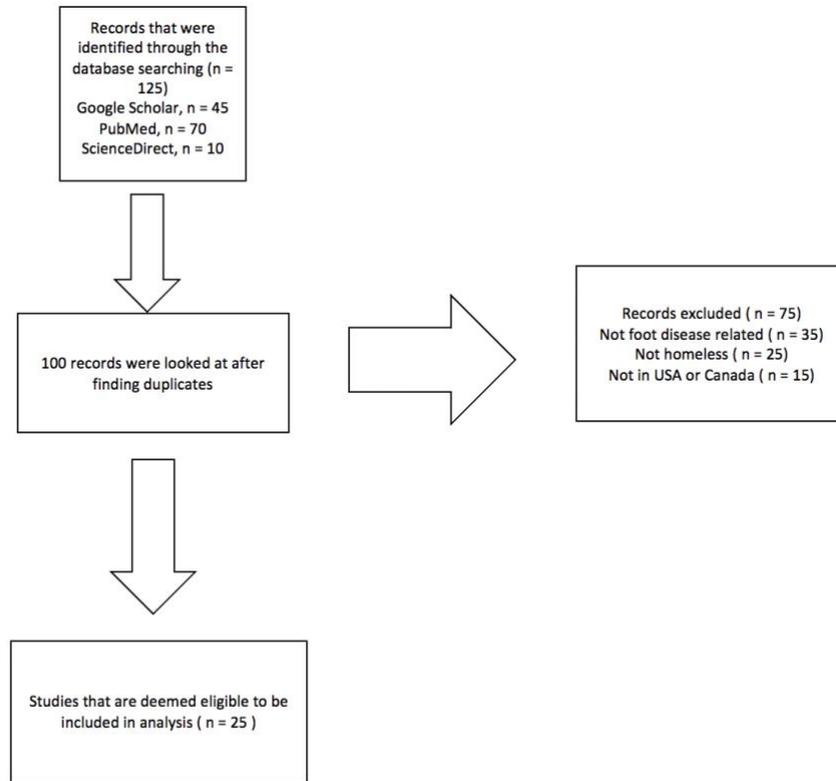
**Figure 3: Pie chart displaying the amount of people who have foot problems from the years 2019-2021**

Over the past three years, there has been an increase in the amount of homeless people who have had foot problems. With the COVID-19 pandemic, it has been trending upward because the unemployment rate has dramatically increased. Thus, there have been more shelterless homeless individuals who are struggling. From 2019 to 2021 the number of homeless people has seen a dramatic increase which will correlate to foot issues. Hopefully, upon the pandemic slowing down the numbers should not spike up but rather slim back down.

## **Chapter Five: Findings from the Literature**

Homeless individuals understand that they should be seeking help for their foot problems, however, there are several different barriers that are preventing them from doing so. Adult homeless suffer the usual skin diseases common to non-homeless adults, and in addition, they can suffer more frequent infections, dermatitis, and wounds related to their compromised living status (Romero, Broder, Natsis, and Bodor, 2018). In the older population, females tend to experience more foot pain than their counterpart (Chuter, Searle, and Spink, 2016). This may be due to inadequate access to clean clothes and bedding, washing facilities, and properly fitting shoes (Romero, Broder, Natsis, and Bodor, 2018). These individuals also tend to delay seeking healthcare due to limited financial means, lack of insurance, or other access problems (Romero, Broder, Natsis, and Bodor, 2018). The homeless report they have a high amount of health care that are not fulfilled. Since the homeless have limited means of healthcare they rely heavily upon people volunteering to check out their physical health.

The search yielded potentially eligible articles, but after screening as outlined in Methods and Figure 1, only 25 articles were relevant to this research. Those articles were then placed in a Data Table (Table 2). Studies were also placed in a quality table (Table 3).



**Figure 4: PRISMA flow diagram**

This figure was used to determine which research articles were deemed relevant to the hypothesis and research. 125 articles were originally found between Google Scholar, PubMed, and ScienceDirect but only 100 were used because of some duplicate articles that provided the same information. Upon doing table 3, it showed there were only 25 articles that were able to be used because it talked about either socks, shoes, weather, and shelter. This was a way to keep all the articles neatly organized.

Author	Type of study	Location	# of participants	Total percentage of Homeless	Results and Conclusion
<b>Rathjen, Shahbodaghi, Brown, 2019</b>	Cohort	USA	300	100	Homeless individuals who live outside developed frostbite within the first couple months
<b>Basit, Wallen, Dudley, 2021</b>	Cohort	USA	250	100	Homeless population struggled with surviving frostbite during the winter compared to summer
<b>Grill, 2017</b>	Single	USA	476	100	Homeless individuals who live outside during the winter suffer from cold feet at a very rapid rate
<b>Thomas, 2019</b>	Single	USA	542	100	Volunteer nurses provide health care to homeless individuals that are in shelters or in the streets as they know the homeless do not trust most professional healthcare workers in a hospital setting.
<b>Endorf, 2021</b>	Single	USA	50	100	Homeless individuals would rather not go to the hospital because they can't afford the cost of it so they try to find their own ways to fix foot problems
<b>Souza, Mirza, Karkada, 2021</b>	Cohort	Canada	124	100	These homeless individuals had a lack of shoes, so they wore flip flops and developed athlete's foot
<b>Singh, Nalk, 2004</b>	Cohort	USA	76	100	The homeless did not have socks along with misfitting shoes so they developed tinea pedis and pitted keratolysis

<b>Brothers and Van Zoost, 2016</b>	Single	USA	235	100	The homeless wore the same pair of socks for several months in a row with washing so they developed a variety of foot diseases but those who lived outside developed foot diseases quicker than those who lived in a shelter
<b>Zimmerman, 2019</b>	Cohort	Canada	89	100	Those that are homeless who live in a shelter are not walking as much as those who do not live in a shelter, so they are not on their feet as much. Thus, those who live outside and wearing shoes that do not fit in this study developed fungi on their feet
<b>Chappell, 2015</b>	Single	USA	147	100	The homeless are not given a stable shelter to live at so they get ordered by the police to leave the park they are sleeping at for the night and by continuing to walk several miles they add more tension to the pain in their feet and so a common foot disease they develop is trench foot
<b>Hill, 2019</b>	Single	USA	246	100	The homeless who wear misfitting shoes for at least three months developed ingrown toenails
<b>Brothers and Van Zoost, 2016</b>	Cohort	USA	287	100	The weather plays a key role in the homeless individuals obtaining fungi on their feet

<b>Zhao, Ma, 2015</b>	Cohort	Canada	300	100	The homeless who wear misfitting shoes and reuse the same pair of socks developed tinea pedis and trench foot
<b>Makgatho, 2015</b>	Single	USA	100	100	It is essential for the homeless to change their socks and shoes especially adult males because they develop very sweaty feet
<b>To and Brothers, 2002</b>	Single	USA	110	100	The average homeless individual walks an average of 5 or more hours per day but those who do not live in shelters walk about an extra 4 miles as they try to find a different place they can settle in
<b>Carpenter, 2007</b>	Single	USA	134	100	A female who was homeless was wearing the same pair of socks for an extended period of time but one day got stuck in rain and her socks were drench along with her shoes and since she had nowhere to dry them, she developed trench foot/immersion foot
<b>Nash, 2018</b>	Single	USA	167	100	Shoes that are worn indoors will not develop the number of bacteria than those that are worn outside so those who do not live in a shelter develop bacteria at a greater rate than those who live in a shelter
<b>Costello Jr, 2017</b>	Cohort	USA	195	100	Frostbite is able to develop in roughly 30 minutes so those who are in a shelter and not on their feet

					as much have a little bit of an edge compared to those who are not sleeping at a shelter
<b>Sheila D'Souza, O'Mahonyl, and Achoba, 2021</b>	Single	USA	65	100	Only 16 percent of the 65 individuals surveyed in the study have a car that can be used to sleep in so this means there a significant number of people who are constantly on their feet and continue to put themselves at risk for foot disease(s)
<b>Tan, Wang, 2017</b>	Cohort	USA	147	100	The ongoing COVID-19 pandemic has increased the homeless population and therefore shelters do not have enough beds for them so it has led to several individuals constantly walking to find a place to settle in
<b>Chen, 2018</b>	Cohort	USA	123	100	Males are less likely than females to wear flip flops so females develop foot diseases at a greater rate than males
<b>Wen, Hudak, and Hwang, 2007</b>	Single	Toronto	100	50	The homeless are less likely to trust the health professionals when compared to the average individual who is not homeless because they feel stigmatized
<b>Stratigos and Katsambas, 2022</b>	Single	USA	142	100	shelter in Boston that showed that out of 142 homeless men that stayed overnight at a well-known Boston shelter for roughly 3

					months, 38 percent obtained tinea pedis, 20.4 percent obtained pitted keratolysis and 15.4 percent obtained
<b>Flemming and Campbell, 2018</b>	Cohort	Canada	127	50	Due to the limited healthcare and how they feel stigmatized the homeless individuals do not have their foot issues address immediately checked out like a normal individual, who will get get their issues check upon ASAP

**Table 2: Summary of all the 25 relevant articles**

### *Settings*

The United States and Canada have a significant number of homeless individuals who are suffering from homelessness, especially in the observed area of study: foot disease(s). These two countries have a significant amount of homelessness that is taking place in their respective countries, and it will continue to increase with the on-going COVID-19 pandemic.

### *Sample*

The 25 relevant articles had just around 4,532 homeless individuals surveyed from 2016-2022. There is a relatively low number compared to the number of homeless individuals in the two countries but it gives an idea of the trends that are occurring. Some of the common trends are that the weather plays a key factor in how quickly the foot diseases will occur, the homeless tend to feel uncomfortable at the doctor's office/hospital, and females put themselves at great risk to obtain a foot disease since they wear flip-flops as their footwear when they walk.

### *Survey*

Upon reviewing Table 2, it can be concluded that those who are living outside are at a significantly greater risk to obtain bacteria/fungi infection on their feet than those living in shelters. This is because those who are homeless living in a shelter are not constantly on their feet as much. Those who are on the streets, often get told by the police to get up from their respective spot and move along. The homeless are walking an approximated average of at least 5 hours per day (Zimmerman, 2019 ).

Similar to a car building up mileage, these individuals are putting on several miles on their feet and they are not wearing very comfortable footwear, if any. Athlete's foot is the most

common foot disease obtained due to lack of wearing shoes. Due to the lack of trust the homeless population as whole has with the healthcare professionals, they will not seek out medical assistance when needed (Hill, 2019). Instead, they will hope to find a volunteer nurse or doctor that is giving back to the community on the streets. The females develop foot disease at a quicker rate than males due to wearing flip-flops at a greater rate than males do.

### *Methodological Quality*

Table 3 was used as a guide to determine if the articles give enough information about the correlations between homelessness and foot disease. The end goal of this study is to see all the different factors that the homeless experience and if there is a certain factor that has a greater effect on the foot diseases occurring. For example, the weather has proven to be a key factor for the homeless who live outside in developing long-term foot diseases (Rathjen NA, Shahbodaghi SD, Brown JA, 2019). This table will allow for seeing which concept was mentioned most frequently.

Element of Assessment	Scoring Criteria	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5	Paper 6
Study Design	0 = Not Experimental ; 1 = Experimental	1	0	0	0	0	0
Outcome	0 = Homeless do not obtain a foot disease but symptoms ; 1 = Homeless obtain a foot disease that is long term	1	1	1	1	1	1
Research Question	0 = not clear; 1 = clear	1	1	1	0	0	1
Mentioning of shoes	0 = no ; 1 = yes	1	1	1	0	1	1
Mentioning of shelter	0 = no ; 1 = yes	1	1	1	1	0	0
Mentioning of socks	0 = no ; 1 = yes	1	1	0	0	0	1
Mentioning of weather	0 = no ; 1 = yes	1	1	1	0	0	0

Element of Assessment	Scoring Criteria	Paper 7	Paper 8	Paper 9	Paper 10	Paper 11	Paper 12
Study Design	0 = Not Experimental ; 1 = Experimental	1	1	1	1	1	1
Outcome	0 = Homeless do not obtain a foot disease but symptoms ; 1 = Homeless obtain a foot disease that is long term	1	1	1	1	1	1
Research Question	0 = not clear; 1 = clear	1	1	1	1	1	1
Mentioning of shoes	0 = no ; 1 = yes	1	1	1	1	1	1
Mentioning of shelter	0 = no ; 1 = yes	1	0	1	1	1	1
Mentioning of socks	0 = no ; 1 = yes	1	1	1	1	1	1
Mentioning of weather	0 = no ; 1 = yes	1	0	1	1	1	1

Element of Assessment	Scoring Criteria	Paper 13	Paper 14	Paper 15	Paper 16	Paper 17	Paper 18
Study Design	0 = Not Experimental ; 1 = Experimental	1	1	1	1	1	1
Outcome	0 = Homeless do not obtain a foot disease but symptoms ; 1 = Homeless obtain a foot disease that is long term	1	1	1	1	1	1
Research Question	0 = not clear; 1 = clear	1	1	1	1	1	1
Mentioning of shoes	0 = no ; 1 = yes	1	1	1	1	1	1
Mentioning of shelter	0 = no ; 1 = yes	1	0	1	1	1	1
Mentioning of socks	0 = no ; 1 = yes	1	1	1	1	1	1
Mentioning of weather	0 = no ; 1 = yes	1	0	1	1	1	1

Element of Assessment	Scoring Criteria	Paper 19	Paper 20	Paper 21	Paper 22	Paper 23	Paper 24	Paper 25
Study Design	0 = Not Experimental ; 1 = Experimental	1	1	1	1	1	1	1
Outcome	0 = Homeless do not obtain a foot disease but symptoms ; 1 = Homeless obtain a foot disease that is long term	1	1	1	1	1	1	1
Research Question	0 = not clear; 1 = clear	1	1	1	1	1	1	0
Mentioning of shoes	0 = no ; 1 = yes	1	1	1	1	1	1	1
Mentioning of shelter	0 = no ; 1 = yes	1	0	1	1	1	1	1
Mentioning of socks	0 = no ; 1 = yes	1	1	1	1	1	1	1
Mentioning of weather	0 = no ; 1 = yes	1	0	1	1	1	1	0

**Table 3: Quality of the Articles**

*Foot Conditions*

Being homeless can be due to the limitations of having a house one can afford, not being employed, or poor mental health. Thus, it is not a fluke that these limitations lead to a repeated cycle for the homeless population that starts with a lack of clothes, food, shelter, social services, transportation and health insurance. Due to lack of space in homeless shelters, there are several individuals who find themselves without an indoor place to sleep. Any individual who

experiences being homeless will be at a much greater risk for malnutrition, poor hygiene, skin and foot conditions, and infectious disease than those individuals who are not homeless (Hill, 2019).

### *Healthcare*

There is a common consensus around the homeless communities that seeking medical help from a health professional is a waste of time. There were roughly 25,216 Canadians in 2018 that had to suffer through being completely homeless and were living in shelters. However, on top of the 25,216 placed in a shelter, there were 6,789 individuals in Canada who were placed in traditional housing (Sheila D'Souza, O'Mahonyl, and Achoba, 2021). There were several of these homeless individuals who opted against getting health care for the foot problems they endure such as blisters, trench foot, athlete's foot because they did not feel like anything would be done for them because of the stigma of being homeless (Sheila D'Souza, O'Mahonyl, and Achoba, 2021) Foot problems affect 6% percentof the population in the United States but 4% percentare homeless (Rigopoulos, Elewski, and Richert, 2018). Of the homeless population, 66% suffer from foot diseases (To, Brothers, Zoost, 2016) It is common for those who are homeless to not want to go to the hospital or doctor's office because they feel there are health care professionals who discriminate against them so they feel it is a waste of their time and would rather suffer with the pain they have (Chappell, 2015). This is not claiming all doctors or majority of doctors are bad. The homeless feel there a small number of doctors who feel this way. Due to the homeless individuals not seeking the limited help they can get; the foot issues do not get diagnosed immediately and will become worse over a gradual period of time.

## *Weather*

The weather will also be a significant factor when these foot diseases occur for those who are living outside. There are some studies that were conducted that show the horrible foot conditions the homeless individuals endure. One study reported that there was 86% of individuals who felt foot pain and they were living outside (Sheila D'Souza, O'Mahonyl, and Achoba, 2021). Those who were living outside had to endure limited access to daily hygiene which leads to dirty socks being worn repeatedly day and night. This created a high risk for athlete's foot, also referred to as tinea pedis. The 86% of individuals who were living outside did not feel comfortable taking off their shoes and socks at night because they felt they would be in the same spot they left them when they woke up the next morning (Sheila D'Souza, O'Mahonyl, and Achoba, 2021). Due to the wet and marshy conditions in Florida, it is inevitable that someone who is living outside with no shoes will obtain fungi on their feet. Thus, the homeless population would rather take their chances by wearing dirty socks, a recipe for problems as athlete's foot is a fungus that will form in an area that has warm and moist conditions, such as the one found in wet old socks. Athlete's foot also known as tinea pedis occurs due to dermatophyte fungi. This type of fungi can only grow with the help of keratin and create infections on hair, nails and skin. Tinea pedis is commonly caused by *Trichophyton rubrum*, *Epidermophyton floccosum* or *Trichophyton interdigitale*. These fungi grow in an environment that has high sweat, high exposure to water, and even walking barefoot. The best way to prevent athlete's foot is to keep one's foot clean and dry (Carlo and Bowe, 2002). There were some individuals who were attempting to air-dry both of their feet and find safe places where they could place their shoes and socks such as a secluded

beach (Carlo and Bowe, 2002). Thus, it is inevitable for the homeless population to develop this disease when they are not wearing a new clean pair of socks each and every day.

## **Chapter Six: Supporting Case Studies**

The data from the studies is from the United States and Canada. There were several factors that affected the homeless community as mentioned in chapters one through five. These factors included but were not limited to: lack of shelter, misfitting shoes, lack of shoes, repeated use of same pair of socks, weather, education, limited healthcare and transportation, and are considered as some of the main causes of foot diseases occurring in the homeless population. The data obtained look at a key factor of whether those that were experiencing these issues were homeless in a shelter or, they were homeless living in the streets. The homeless community is continuing to expand with the on-going COVID-19 pandemic as according to the U.S. department of housing and Urban Development's (HUD) 2020 annual Homeless Assessment Report shows that 580,466 individuals were counted as homeless which was a 2.2% increase over 2019 and there was a 7% increase in unsheltered homeless. Thus, the objective is to continue to bring awareness to these issues for those that are voiceless.

### **Lack of Shelter**

In a survey conducted by Melba Sheila D'Souza, Joyce O'Mahony and Alfred Achoba in January of 2022, there were 65 people surveyed in a study to display the current living situation of a select homeless population. Only 53% of them had the fortune of living in a shelter (Sheila D'Souza, O'Mahony, and Achoba, 2021). Thus, there is nearly half of the population not living in a shelter but rather outside. Many who sleep outside find themselves a bench to sleep on, covered in old blankets and whatever else they can find to keep warm and dry. Some of the homeless individuals, by choice, opt not to stay at a shelter due to limited bed availability. For instance, the states of Delaware, Kansas, Maine, and West Virginia are able to have enough beds

for roughly 90% of their individual homeless population. However, in 1988 it was reported that the West Coast only has less than half the bed availability for their individual homeless population. Thus Therefore, it will lead to select individuals getting arrested on purpose to have a place to stay-in (Chappel, 2015). The 53% of homeless individuals living at a shelter will be informed of resources that are available to them compared to those living outside typically will have limited access to resources as shelters will tend to help individuals out by having volunteers.

### **Lack of Shoes and Weather**

Researchers found that those in the homeless population who wear flip-flops for a majority of the time are at a much greater risk to develop a foot disease like athlete's foot (tinea pedis), or trench foot especially, if they live outside (Chen, Wong, Xu, Tan, Wang, Luximon, Zhang, 2018). Flip-flops typically feature a thin, flat, and flexible sole attached with few straps in the forefoot region (Chen, Wong, Xu, Tan, Wang, Luximon, Zhang, 2018). Without the protection of heel contour that is commonly seen in the closed-toe shoes, flip-flops wearers largely expose their hindfoot and receive no supports to the heel and ankle due to the limited foot/shoes contacts. This minimalist structure was speculated to cause many foot problems associated with mechanical instability (Chen, Wong, Xu, Tan, Wang, Luximon, Zhang, 2018). With flip-flops, wearers also normally do not have socks on, allowing direct contact between the skin and environment, making them more prone to coming in contact with a contagious agent such as *Candida albicans*. The easiest disease to develop due to lack of shoe wearing is athlete's foot. Athlete's foot is a disease that is ordinary found in the homeless community. There are homeless individuals who do not bother wearing shoes because they do not fit them. It is estimated that around 40% of the males that are homeless do not wear shoes that properly fit

them as they are either too big or too small (To and Brothers, 2002). The homeless individuals walking as a common way of transportation takes a toll on the feet when not wearing appropriate fitting shoes. Ingrown toenail is a common problem resulting from various etiologies including improperly trimmed nails, hyperhidrosis, and poorly fitting shoes. Patients commonly present with pain in the affected nail but with progression, drainage, infection, and difficulty walking occur (Zuber, 2002). A study conducted in Boston showed that out of 142 homeless men that stayed overnight at a well-known Boston shelter for roughly three months, 38% obtained tinea pedis, 20.4% obtained pitted keratolysis and 15.4% obtained ingrown toenails (Stratigos and Katsambas, 2022).

Ingrown toenail shall be defined as a common condition in which the corner or side of a toenail grows into the soft flesh (MayoClinic.org). The result is pain, redness, swelling, and sometimes an infection. Ingrown toenails usually affect the big toe. Another disease that homeless individuals often develop from a lack of shoes is pitted keratolysis, which is a non-inflammatory bacterial infection caused by cutaneous infection with *Micrococcus sedentarius*. The lesions consist of small, crater-like depressions in the stratum corneum commonly seen on the soles of the feet and occasionally on the palms of the hands. These small pits that extend about two-thirds of the way into the stratum corneum may coalesce into large craters, rings of craters, or erosions (Zhao, Ma, 2015). Pitted keratolysis has a worldwide distribution, but it is more common among barefooted people living in tropical areas, such as Florida, and can affect patients of any age; however, adult males with sweaty feet are most susceptible, making up 97% of the cases seen (Singh, Nalk, 2004). To avoid these diseases, regular changing of footwear and socks is essential (Makgatho, 2015). This is a challenge for homeless individuals as they are limited on money and supplies, as socks are among the least donated clothing items

if not the least. Thus, a consequence they face is diseases to their feet.

It is very rare for someone to develop frostbite and they are living inside. Frost bite is caused by the heavy exposure to select parts of the body to the temperatures that are below the freezing point. The individuals of the homeless community (roughly 47%) are at a high risk to endure frostbite when it is wintertime. Thus, when it is summertime the homeless are dealing with athlete's foot because it occurs when there are wet and marshy conditions but, in the wintertime, they deal with a potential cause of frostbite because of freezing temperatures.

### **Transportation and Rewearing the Same Pair of Socks**

Walking is rather common for the homeless as they do not often have access to a car of their own, therefore it leads these individuals to experiencing severe foot problems. The average homeless individual walks a minimum of five or more hours a day (To and Brothers, 2002). As one would imagine, this takes a toll on the feet of the average homeless individual who is most likely not wearing something comfortable on their feet. Due to lack of space in homeless shelters, there are several individuals who find themselves without an indoor place to sleep. Therefore, the park is a rather common and ordinary place for homeless individuals to spend their night as they are attempting to find a bench or a safe place on the ground to get some sleep (Chappell, 2015). Unfortunately, there are police officers who will force these individuals to leave the park bench they are sleeping on. There is currently a battle ongoing about the law stating that "No person shall sit, lie or sleep in or upon any street, sidewalk, or other public way." There have been ongoing talks about the town officials trying to close the park at the Ocean City Inlet overnight (Chappell, 2015). This was going to jeopardize the place that the homeless sleep. There are several parks that are discussing doing this and it forces the homeless to get back on their feet

and continue to walk some more on their aching feet. This repeated search for a place to sleep while wearing no shoes or flip-flops, will take a toll on the individual's feet. Only 16% out of the 65 individuals surveyed in the study conducted in Portland, Oregon have a car to use to sleep in (Sheila D'Souza, O'Mahonyl, and Achoba, 2021). This means that there are at least 75% of individuals who are constantly walking. In the same study, one homeless individual said "I have to walk for my daily needs, but the cold or heat is exhausting and tiring" (Sheila D'Souza, O'Mahonyl, and Achoba, 2021). There is another individual who expressed frustrations they endure on a day-to-day basis before having to be in a constant move, but at least have a tent where they were able to settle into. However, they said "here in Portland, having to move from camp to camp, I have to keep my shoes on because people make off with them. Then your feet can't get air. My feet are constantly in pain," (Hill, 2019). This individual developed athlete's foot due to the constant pressure put on their feet and lack of proper shoe attire. Those who are living in shelters do not have to experience the pain of constant moving around at night because they are in "legal" place to sleep. Another instance of constant movement is there was a 48 year old African American female who was walking roughly 10 hours a day trying to find places new places to stay after becoming homeless. She was wearing the same pair of socks for an extended period of time and one time she got caught in the freezing rain and her socks became drenched. She was diagnosed with trench foot/immersion foot where the foot's soles on both feet were completely swollen, grey and wrinkled (Carpenter, 2007). The rewearing of the same pair of socks will eventually lead to severely high levels of bacteria that grow on the feet. The bacteria that is on the dirty feet will have a great chance of enzymes being formed and nutrients in the body to degenerate which will lead to infections (Gupta, 2019). There was a study conducted that

showed the importance of wearing a clean pair of socks. There are several individuals in the world who do not view socks as something that is a necessity. However, one would be surprised to know that wearing socks will lead to less bacteria that builds up. (Nash, 2018). The low-top Converse are very common to not wear with socks but by doing this it will generate three times more bacteria (Nash, 2018). Gym shoes create less bacteria than shoes that are used every day, as daily beaters as they do not touch the outdoor ground as often as the daily beaters. Thus, those who are homeless and living outside will develop the bacteria at a much greater rate than those who are not outside as often.

After going through all the data, the hypothesis was proven that the homeless individuals will suffer from foot disease due to footwear and weather. However, it should be noted that socks were not mentioned heavily in the literature reviews. They only played a minor factor according to the articles that were found.

## Chapter Seven: Discussion

Given the ongoing COVID-19 pandemic, the homeless population is not going to be diminishing relatively soon. As seen in figure 6, the trend is increasing for the homeless individuals dealing with foot issues. Thus, everyone in their respective communities is going to need to be a team player for the future years and help give back to those that are in need. It will be a challenge to give every homeless individual multiple clean pairs of socks and shoes as they will not have easy access to affordable washers and dryers. However, after the discovery of seeing that those who are homeless and living in shelters develop foot diseases at a far less rate than those living outside, it is essential each community tries to create more room in shelters. The diseases discussed in this research are preventable but that will only happen if there is more awareness brought to this manner. For instance, for those living outside they are at extreme risk of frostbite which can occur in 30 minutes or less according to the Mayo Clinic (Costello Jr, 2017). By figuring out ways to create more room in shelters, this will allow for the struggling homeless individuals to not be suffering alone but be provided help. Unfortunately, this issue is completely flying under the radar and needs to be addressed.

As shown on this paper, homelessness has been linked to increased foot disease. The homeless community tends to be altered significantly by the living situation and the gender. Those who are homeless and live outside develop foot infections/diseases at a greater rate than those who are living in a shelter. The weather plays a vital role in what type of foot diseases the homeless will likely obtain. Since females wear flip flops more often than men, they put themselves at a severe risk to develop foot diseases when walking several miles, a day. Since a heavy majority of the homeless community do not have cars, they walk to every location they go

to. This will create extreme tension in the feet that are constantly suffering from improper footwear. With the on-going pandemic the homeless population will continue to increase, and the United States and Canada are not equipped to deal with more homeless individuals as they are currently struggling to help the current population at hand.

## **Addendum Appendix A:**

**Athlete's foot (tinea pedis):** A skin infection caused by a fungus called Trichophyton that thrives within the upper layer of the skin when it is moist, warm, and irritated.

**Foot ulcers:** are open sores or lesions that will not heal or that return over a long period of time. These sores result from the breakdown of the skin and tissues of the feet and ankles and can get infected. Symptoms of foot ulcers can include swelling, burning, and pain.

**Frost bite:** is tissue damage as a result to cold exposure, occurring at temperatures below 0 degrees C.

**Immersion foot:** is an injury of the feet resulting from prolonged exposure to wet and cold conditions.

**Ingrown toenail:** A common disorder, particularly on the big (great) toe, in which the corner of the nail curves down into the skin due to mis trimming of the nail or due to shoes being too high.

**Pitted keratolysis:** is a skin disorder characterized by crateriform pitting that primarily affects the pressure-bearing aspects of the plantar surface of the feet and, occasionally, the palms of the hand as collarettes of scale.

**Onychomycosis:** is a fungal infection of the nails that causes discoloration, thickening, and separation from the nail bed.

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