



Foot Health Assessment and Problem Identification in a Dominican Batey Community

A Descriptive Study

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ABSTRACT

PURPOSE: Foot problems can adversely impact foot function and quality of life. Foot problems are often overlooked, particularly in populations with limited health care access. Little is known about the foot health of Haitian immigrants who live and work in the bateyes (rural sugarcane villages) of the Dominican Republic. These immigrant workers may experience foot problems that could affect foot function and the ability to work and provide for their families.

DESIGN: Cross-sectional, exploratory, descriptive study design.

SUBJECTS AND SETTING: A convenience sample of adults was recruited from an ongoing community-based participatory research project evaluating a mobile hypertension screening and treatment clinic program in 11 Dominican batey communities.

METHODS: Foot health was assessed using the Foot Problems Checklist, a 24-item survey instrument developed for this study based on a review of the literature and foot clinician expertise. A certified foot care nurse recorded foot health data on the Foot Problems Checklist via visual and physical inspection.

RESULTS: Study participants were 25 females and 16 males, aged 18 to 90 years, and all had at least one foot health problem. The most common foot problems were calluses (78%), dry skin (76%), thick nails (59%), jagged nails (29%), long/overgrown nails (17%), and skin fissures (12%).

CONCLUSIONS: While the foot problems we observed were not considered serious, they could become progressively debilitating and be prevented with proper self-management guided by appropriate knowledge and skills and available supplies. We recommend the development and testing of foot care self-management interventions deliverable via mobile clinics to increase access and improve foot health outcomes.

KEY WORDS: Bateyes, Dominican Republic, Foot care self-management, Foot problems.

INTRODUCTION

Global statistics regarding the overall prevalence of foot problems are lacking; however, based on the available extant literature, it is estimated that between 40% and 80% of adults experience foot problems.¹⁻⁴ Unfortunately, many people ignore foot problems until they progress to a debilitating condition. For example, inadequate self-management of foot skin and nail problems can quickly lead to tinea pedis or a more serious infection such as cellulitis.⁵ Even common foot problems such as corns, calluses, bony deformities, and long or thick toenails can cause discomfort and limit mobility.^{6,7} In addition, foot problems can adversely impact quality of life, impede

an individual's ability to perform activities of daily living and function independently, and be associated with depression.^{6,8,9}

In developed countries, promoting foot health has become a focus in the clinical practice setting. However, little is known about foot health in low-resource countries. The Dominican Republic, although a middle-income country, is home to hundreds of sugarcane villages, known as bateyes. These sugarcane villages are typically located in remote, rural, and geographically isolated parts of the country. Batey residents often perform physically demanding work that requires many hours of standing and/or walking long distances, for example, working in the fields harvesting sugarcane for up to 12 hours a day.¹⁰ Other farm workers, such as those living in rural Korea, report a high prevalence of leg and foot pain.¹¹ These physical activities likely put batey residents at risk for foot health problems.

Certain disease states can also negatively impact foot health. Diabetes mellitus is a well-documented risk factor for foot problems, and unhealed leg or foot ulcers have been found in individuals with type 2 diabetes mellitus living in rural villages in the Dominican Republic.¹²⁻¹⁵ Hypertension and its complications also are associated with foot problems.^{13,16} Hypertension is a common chronic health condition among batey residents, who are predominantly of Haitian descent.¹⁷ Given that hypertension is considered an important risk factor for

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the incidence and progression of peripheral artery disease,^{18,19} the prevalence of hypertension in batey communities put this population at a higher risk for serious foot health problems. Thus, the purpose of this study was to explore the foot health of adults living in rural batey communities in the Dominican Republic.

METHODS

In this cross-sectional, descriptive study, we used a convenience sample of adults that was recruited from an ongoing community-based participatory research project evaluating a mobile hypertension screening and treatment clinic program in 11 Dominican batey communities.²⁰ Adults attending the mobile hypertension program at one batey in southeastern Dominican Republic and other members of the local community were invited to take part in the foot health study using a word-of-mouth, snowball recruiting strategy. Data collection occurred in October 2017 at a local church that routinely hosts the hypertension program.

Ethical Acknowledgment

Prior to the initiation of the study, approval was obtained from the institutional review board (IRB) of the University of Missouri (IRB #2009365). The project was also reviewed and approved by the 2 community partners, Fundación Enciende Una Luz (Light a Candle Foundation) and the Dominican Republic Medical Partnership. When participants came to the mobile hypertension clinic, they were invited to join the foot health study. An interpreter was present to assist with explaining the study, reading the consent, answering questions, and obtaining informed consent to the primarily Spanish-speaking population. Each participant received a foot care kit containing nonmetal emery board nail files, a pumice stone with brush, and a small bottle of hypoallergenic skin lotion as compensation for their time.

Instruments

Data on foot problems were collected with the Foot Problems Checklist, an instrument developed for this study based on a review of the literature and foot clinician expertise. The Foot Problems Checklist consisted of 24 observable foot problems such as nail and skin conditions, bony deformities, skin ulcerations, and gangrene (Table 1). Items on the Foot Problems Checklist are among the most commonly reported foot conditions and those most likely to cause foot pain, impair physical mobility, and adversely impact quality of life and work productivity.^{6,21} Face validity of the Foot Problems Checklist was established by having an independent panel of 5 doctorally-prepared nurses with expertise in skin, nail, wound, and foot care review the checklist. Minor modifications were made to the Foot Problems Checklist based on expert panel feedback to improve individual item clarity and/or overall instrument comprehensiveness. For example, an "Other" category was added to document any observed foot problems not on the Foot Problems Checklist. Potential items suggested for the "Other" category included adornments, embedded objects, infestations, melanomas, or other foot deformities. The Foot Problems Checklist allows the evaluator to document the presence or absence of each foot problem as well as the foot involved: left, right, or both. The Foot Problems Checklist did not rate severity of the foot problems observed.

TABLE 1.
Foot Problems Checklist

Foot Problem	Present		If Present, Left or Right Foot?	
Long or overgrown nails	Yes	No	Left	Right
Thick nails	Yes	No	Left	Right
Jagged, unevenly cut nails	Yes	No	Left	Right
Ingrown nails	Yes	No	Left	Right
Curved nail(s) (C-shaped)	Yes	No	Left	Right
Corn(s)	Yes	No	Left	Right
Callus(s)	Yes	No	Left	Right
Skin fissures (heels)	Yes	No	Left	Right
General skin dryness	Yes	No	Left	Right
Pedal edema	Yes	No	Left	Right
Skin trauma/cuts/abrasions/blisters	Yes	No	Left	Right
Dermatitis/eczema/psoriasis/dermopathy	Yes	No	Left	Right
Redness/erythema/warmth	Yes	No	Left	Right
Pallor/coolness	Yes	No	Left	Right
Interdigital maceration	Yes	No	Left	Right
Athlete's foot	Yes	No	Left	Right
Plantar wart(s)	Yes	No	Left	Right
Bunion/hallux valgus	Yes	No	Left	Right
Hammertoe	Yes	No	Left	Right
Charcot foot	Yes	No	Left	Right
Missing digits	Yes	No	Left	Right
Ulcer/Open wound	Yes	No	Left	Right
Dry gangrene	Yes	No	Left	Right
Other (adornments, embedded objects, infestations, melanomas, other foot deformities)				

Procedures

Data for the study were collected in the same one-room church in which the mobile hypertension clinic occurred. Interested participants lined up in chairs to be interviewed and examined. One by one, participants were called to sit in a chair next to the examiner who is a certified foot care nurse (J.O.). Informed consent was obtained by the interpreter who remained in close proximity during the entirety of data collection. After obtaining informed consent, age and sex data were obtained from participants via self-report. The examiner (J.O.) donned gloves, removed the participant's footwear, and cleansed each foot with hypoallergenic wipes. All aspects of both feet were visually and physically inspected, and foot health data were recorded on the Foot Problems Checklist. Type of footwear, if any, was also recorded. After the inspection, lotion was massaged into the skin of both feet and the footwear was replaced. Each visit lasted less than 10 minutes.

Data Management and Analysis

In the Dominican Republic and during travel back to the United States, coded hard copies of data were stored in a locking clipboard (Vaultz, Cleveland, Ohio), and the clipboard was kept under the direct supervision of the investigators at all times. Upon return to the United States, data were double entered

into an Excel spreadsheet, checked for accuracy, and stored on a secure, password-protected server at the University of Missouri. Data were analyzed using the Statistical Package for Social Sciences software, version 24 (SPSS, Armonk, New York). General descriptive statistics such as frequency distributions, means, and standard deviation were used to summarize the data. Bivariate associations of foot problem type and sex were examined using the χ^2 test. Multivariate associations of foot problem type and sex while controlling for age were examined using binary logistic regression. Level of significance was set at $P < .05$.

RESULTS

Forty-one adults from one batey located in the Southeastern Dominican Republic participated in the study. All participants ambulated independently to the study site. Although the sex of the population was predominantly female (61%; $n = 25$) and mean age was 54 years, the sample ranged in age from 18 to 90 years.

All participants presented with at least one foot problem. Of the 24 possible items on the Foot Problems Checklist, 13 problems were noted. The majority (75%; $n = 18$) of the problems observed were skin or nail related (Table 2). The 6 most common problems were calluses, dry skin, thick nails, jagged or unevenly cut nails, long nails, and skin fissures. Only 2% of participants experienced hammertoes, ingrown nails, maceration between toes, missing digits, or tinea pedis. Problems in the "Other" category included an ankle deformity, flat feet, missing toenails, and a partially detached toenail. No serious infectious, orthopedic, perfusion, or traumatic foot problems were identified.

The type of foot problem varied depending on sex (Figure). Specifically, being male was associated with thicker toenails ($\chi^2_1 = 5.57$; $P = .018$). The odds of males having thick toenails was 4.9 times higher (95% confidence interval, 1.0-23.4; $P = .048$) than the odds of a female having thick toenails. Advancing age was not associated with the total number of foot problems ($P = .107$) or any specific foot problem.

All participants wore shoes to the clinic. Approximately 93% ($n = 38$) wore flip-flops; the remaining 7% ($n = 3$) wore slip-on shoes. None of the participants wore lace-up shoes or socks.

DISCUSSION

In our study of the foot health of adults living in the bateyes of rural areas of the Dominican Republic, we found foot problems were highly prevalent, affecting all 41 study participants.

TABLE 2.
Most Frequent Foot Problems in Adults Living in Dominican Bateyes

Problem	n (%)
Callus(s)	32 (78)
General skin dryness	31 (76)
Thick nails	24 (59)
Jagged, unevenly cut nails	12 (29)
Long or overgrown nails	7 (17)
Skin fissures (heels)	5 (12)
Curved nail(s) (C-shaped)	3 (7)
Pedal edema	3 (7)

The most frequent foot problem was callus formation, which is consistent with prior research in homeless individuals, another vulnerable population with limited access to health care resources.⁵ In addition, while the majority of the participants wore "inadequate footwear" based on health care standards of developed countries, no severe foot problems were noted.

One reason for the relative health of participants' feet may be the result of physical activity levels. Due to their limited access to transportation, adults living in the bateyes walk everywhere they need to go in very minimal footwear. While the use of flip-flops for walking distances is discouraged in developed countries, there is evidence to support the hypothesis that those wearing sandals with minimal cushion and arch support have more well-developed foot muscles and stronger arches than those who wear more modern shoes.²² We noted that all study participants had extremely well-developed abductor hallucis muscles, likely due to the amount of walking these sugarcane workers and their families do on a daily basis. Prior research has demonstrated that adults with the best foot health report high levels of physical activity; thus, walking likely may have a protective effect on foot health in this rural population.²

Current literature suggests that flip-flops are associated with increased trips and falls, do not provide protection from environmental and/or occupational injuries, and increase the risk of developing shin splints.²³ In addition, flip-flops are associated with a shorter stride and slower walking speed.^{24,25} Despite wearing inadequate footwear, none of the study participants had foot problems that would limit their functional ability. The lack of corns, bunions, or toe deformities such as hammertoes or mallet toes is likely related to wearing flip-flops that do not rub the tops or ends of toes. While the openness of the flip-flops likely has a protective effect against tinea pedis, which is more common when occlusive shoes are worn, the high rate of calluses found primarily on the soles of the feet could be related to friction and the lack of cushion on the insoles of the flip-flops.⁵

Callus formation, also called hyperkeratosis, occurs in response to abnormal pressure and friction applied to an area of the foot skin surface.⁷ Risk factors for hyperkeratosis can be either intrinsic such as anatomical foot deformities or extrinsic including ill-fitting shoes or high activity levels. The most likely cause of calluses in this study was high physical activity levels—specifically, walking everywhere and standing during working hours. Chronic pressure from constant walking and friction and/or shear to the foot from shoes such as flip-flops with minimal arch support or plantar padding can cause an increase in keratinocyte activity and a thickening of the skin. For people living in the bateyes, these calluses may actually serve as a natural protective barrier to help safeguard their skin from breakdown and subsequent infection.

Unfortunately, an overdeveloped callus can further increase pressure and may, ultimately, worsen the problem—especially in individuals with "at-risk" feet such as those with diabetes mellitus and/or peripheral artery disease.¹³ Pain from calluses can cause changes in gait and balance and decrease work productivity.^{7,26} Thus, public health and other health care professionals serving populations living in bateyes and similar low-resource populations are encouraged to develop screening programs to help identify individuals with "at-risk" feet. Providing footwear with arch support and insole padding specifically for individuals with risk factors and preventing and early treatment of calluses would help decrease excessive callus development, skin breakdown, infection, pain, and mobility

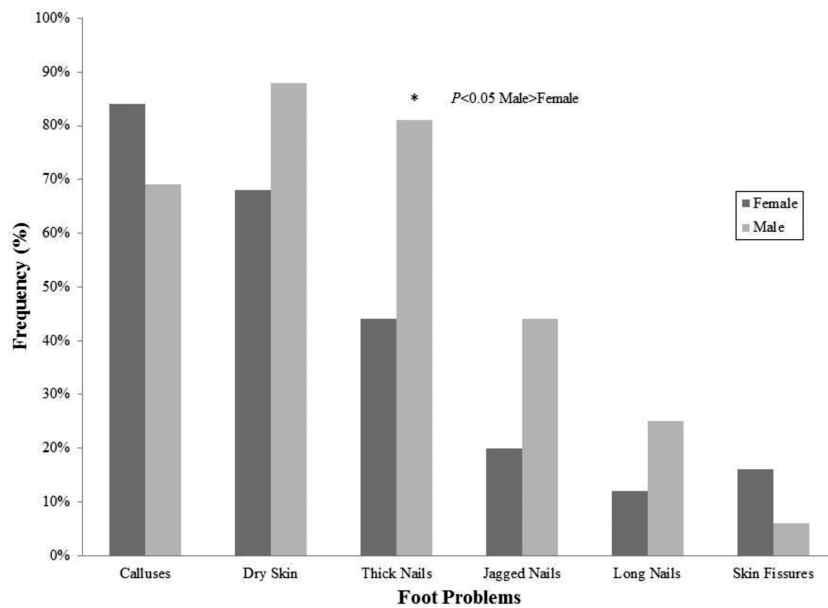


Figure. Frequency of foot problems in Dominican batey residents by sex.

impairments. In addition, attention to foot health may help assure that people can continue to work and provide for their families.

Physiologic factors may make the batey residents at a greater risk for callus formation. Recent literature notes that thinner fat pads on the bottom of the foot and a lower body mass index (BMI) are also risk factors for callus development.²⁷ Specifically, when there is less padding on the plantar surface, the soles of the feet are more susceptible to pressure, friction, and shear. Quantitative BMI data were not available or measured in our study; however, based upon the clinical experience of our team, all participants visually appeared to be either underweight or normal weight. We recommend future foot health research in adults living in bateyes include relevant biophysical measures such as BMI.

Xerosis (dry skin), also prevalent in this sample, is characterized by dull, coarse, rough, and/or flaky skin, which can lead to itching, redness, and desquamation.²⁸ The pathophysiology of xerosis is complex; skin goes through a continuous process of building (keratinization) and then shedding (desquamation) of the stratum corneum, or outer layer of the skin.²⁹ Dryness and flaking are caused by a disruption in the keratinization process and/or changes in intercellular lipids and the hydrolipidic film on the skin.^{28,29} As adults living in bateyes spend their days outside with near constant exposure to high air temperatures, sun, and wind, the high rate of dry skin is mostly likely due to these exogenous factors.³⁰ While dry skin can cause unpleasant symptoms such as itching, extremely dry skin can lead to fissures, or breaks in the skin, which impair the skin's ability to maintain a protective barrier and increase the risk of microbial invasion and infection.²⁸ Primary prevention and treatment of xerosis include daily application of skin cream, a fairly simple treatment that could inexpensively be furnished to individuals at risk of developing severely dry skin by nongovernmental and/or nonprofit organizations providing health care in the bateyes.

The prevalence of thick nails in these participants was comparable to what has been found in other research examining foot health in racially and ethnically diverse populations.^{31,32} While

often considered a superficial, cosmetic problem, thickened nails can cause painful pressure on the nail bed and can break off, leaving rough, sharp edges that can cause further skin injury and may affect an individual's ability to perform work or leisure activities.³³ Thick nails are often caused by a fungal infection (onychomycosis) that invades the nail and nail bed, causing dystrophic changes. As a result, nails become thick, discolored, and hard but friable.³³ Older adults, males, and persons with diabetes, human immunodeficiency virus (HIV) infection, obesity, peripheral artery disease, or venous insufficiency are more likely to develop toenail onychomycosis.^{1,31,34-36} Given the high prevalence of HIV infection in both Haiti and the Dominican Republic, one might expect to see a high rate of toenail infections.³⁷ In addition, many males living in bateyes typically work in the sugarcane fields in open-toed shoes all day; thus, toenail trauma is another likely explanation for the higher prevalence of thick toenails found in males in our study.^{1,34} Prior research suggests that advancing age is associated with an increase in foot problems.^{21,26,28,38-40} Physiologic changes to the aging foot and skin can predispose older adults to calluses, corns, increased joint stiffness, problems with balance, and foot and ankle muscle weakness.^{39,40} Although 78% of the study participants were older than 50 years, we did not find that number or type of foot problems was associated with increased age. It is possible that our study lacked sufficient power due to our small sample size to detect these relationships. Future research should include larger sample sizes and varied age groups to more clearly identify foot health problems specific to this population.

The foot problems identified in this study do not pose an immediate risk to foot function but could progress to more serious problems, such as increased pain, skin breakdown, and infection. Interestingly, the foot problems seen can be easily self-managed, given appropriate knowledge, skills, and supplies. For example, thick nails can be minimized, though not completely eradicated, through filing with an emery board. Dry skin and fissures can be managed using a skin emollient. Likewise, long jagged nails can be trimmed and smoothed with nippers and files. A foot care self-management training program could be added to the activities of the mobile

hypertension program, providing supplies and skills training as part of its overall health promotion programming. People who live in the batey communities likely have limited access to the supplies needed to safely perform foot care self-management behaviors, so provision of foot care supplies would be an important factor in the success of a foot care self-management program within this community. Interventions developed for individuals living in the bateyes should be designed and delivered using culturally and linguistically appropriate materials and interaction to improve self-management behaviors.⁴¹

Strengths and Limitations

To our knowledge, this is the first study to examine foot health in a vulnerable and underserved population living in a Dominican batey community. Additionally, a standardized and reproducible approach was utilized to assess foot health. Study limitations include the small sample size and convenience, snowball sampling of adults from a single batey. Given that the data were collected in a church near the top of a hill, it is likely that only individuals who were physically able to walk up the hill to the clinic were able to participate in the study. As such, homebound individuals or those with severe medical problems were unlikely to be study participants. Thus, our findings may underestimate the severity of foot problems in batey communities. Participants were not interviewed to determine the impact of their foot problems on their overall health or quality of life. Lastly, this study only examined the physical presence of foot problems assessed by one clinician.

CONCLUSION

Adults living in bateyes in the Dominican Republic experience foot problems that, while not immediately threatening to their quality of life or functional ability, could easily become debilitating. The geographic isolation of the sugarcane villages limits the population's access to health care. The high prevalence of nail and skin issues point to a need to develop new strategies to enhance foot health in this population. Fortunately, the foot problems noted in this population are amenable to self-management strategies with appropriate knowledge, skills, and supplies. Additional work is needed to explore the symptom experience of foot problems among batey residents. We recommend further research include development and efficacy testing of foot self-management interventions that could be delivered via a mobile clinic model to remote, geographically isolated communities.

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