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Research Article

Risk Factors of Foot Blisters Formation among Arbaeen Pilgrims: An Observational Study

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Abstract

Introduction: Arbaeen is an annual religious procession in Iraq in which millions of people participate by walking 80 kilometers from the city of Najaf to the city of Karbala. Foot blisters are a common problem for hikers, runners, and endurance athletes, and this study aimed to evaluate the risk factors for foot blisters among Arbaeen pilgrims.

Methods: In this cross-sectional study, 6,972 participants were included, and 4,399 were selected for evaluation during the 2017 Arbaeen ceremony. Demographic data such as age, sex, type of foot covering, presence of underlying diseases, educational level, number and frequency of Arbaeen pilgrimages, traveled distance, and locations of foot blisters were captured.

Results: The type of foot covering and the distance walked were significantly associated with the number of foot blisters (P-value<0.05). However, no association was found between underlying diseases such as diabetes mellitus, hypertension, cardiovascular disease, and thyroid dysfunction and the risk of foot blisters (P-value>0.05). Women were found to be at a higher risk of developing foot blisters (P-value<0.05).

Conclusion: The study concluded that proper footwear and regular foot care are essential to prevent foot blisters during the Arbaeen pilgrimage.

Keywords: Arbaeen, blisters, pilgrimage, foot blisters.

Introduction

Arbaeen is an immensely popular religious procession held annually in Iraq country. Approximately 21 million people are estimated to participate in the Arbaeen pilgrimage in 2019. Arbaeen pilgrims walk a distance of approximately 80 kilometers from the city of Najaf to the city of Karbala [1,2]. Blisters caused by friction on the feet are frequent injuries among hikers, runners, and endurance athletes [3].

Repetitive mechanical forces being applied to the skin can cause a break in the skin's layer, called the stratum spinosum. This break leads to necrosis of the cells in the area and then a filling of the break with a serum-like liquid caused by hydrostatic pressure and sweat from the sweat glands. The skin forms the blister's roof and comprises the three most superficial layers: stratum corneum, stratum lucidum, and stratum granulosum [4]. Foot blisters can cause discomfort and pain, affecting a person's enjoyment of physical activity and leading to changes in their planned activities.

Additionally, blisters can impair the concentration and ability to respond to emergencies and may alter a person's gait, leading to an increased risk of other musculoskeletal injuries [5,6]. To avoid blisters, it is important to have boots that fit correctly, keep your feet conditioned through regular marching, use socks that help reduce chafing and moisture, and optionally use antiperspirants on your feet [7]. Foot blisters often present with local infectious lesions, cellulitis, and sepsis as common complications [9-11]. Since millions of people participate in the Arbaeen pilgrimage, our study aimed to evaluate the risk factors influencing the formation of foot blisters among pilgrims participating in the Arbaeen.

Methods

Participants

For this observational study, data were collected in November 2017. Participants who walked 80 km from the Holy City of Najaf to Karbala and were eligible for foot blister treatment at treatment camps were invited to participate. The inclusion criterion was that they completed a written informed consent form along with a questionnaire. Those who did not answer the questionnaire answered incompletely or had pre-existing blisters were excluded. In total, 6972 people were enrolled in the study, and 2573 were excluded based on the exclusion criteria. The study adhered to the principles of the Declaration of Helsinki.

Data collection

The necessary data were collected using a researcher-made questionnaire containing information such as age, sex, type of foot covering, presence of underlying diseases (such as diabetes and hypertension), educational level, number and frequency of Arbaeen pilgrimages, traveled distance, and locations of foot blisters. The researchers and caregivers filled out each questionnaire during their contact with the participants.

Statistical analysis

The mean and standard deviation were recorded for quantitative variables, and for qualitative variables, the frequency and frequency percentages were recorded. Correlation tests were used for quantitative variables, while the k-square and Fisher tests were used for qualitative variables. A regression test was also used, taking a level below 0.05 as significant. Data analysis was conducted using the SPSS 22 software.

Results

Of the 6,972 participants, 4,399 were selected for evaluation, all of whom had developed at least one-foot blister during the Arbaeen pilgrimage. Participants started their journey from Najaf to the treatment camps. Of the 4,399 participants, 1,623 (36.9%) were women, and 2,779 (63.1%) were men, with ages ranging from 7 to 86 years (mean age 37.7±12.08). During the pilgrimage, 1,544 participants (35.1%) wore slippers, and 2,855 (64.9%) wore shoes. 83% (3651/4399) of the participants were Iranian, while Iraqi, Afghan, and Pakistani included 8% (351/4399), 4% (180/4399), and 3% (132/4399), respectively. The minority participants (85/4399) were from other countries.

To investigate the race of the study`s population, most of them were Fars (2914/4350 or 67%), and Turk and Arab pilgrims included 15% and 10% of the participants, respectively. The participants visited treatment camps at different distances from Karbala city, with 175 (4%), 2,395 (54.4%), and 1,829 (41.6%) visiting camps located 17.3, 26.4, and 56.8 km away, respectively. In addition, 6.6% (256) of the participants had a history of diabetes mellitus (DM).

Hypertension and smoking were other common underlying medical diseases after diabetes mellitus (3.02 % and 2.03%, respectively). The underlying diseases and smoking statuses of the patients are shown in Table 1. The number of foot blisters ranged from 1 to 20, with most patients having 1 or 2 blisters (Table 2). Furthermore, 15% of the patients had less than a diploma, 29% had a diploma, and 1% had a doctoral degree (Table 3). The foot was divided into four zones, with 82% of patients having blisters in their foot fingers (zone 1), 12% in the plantar surface of the feet (zone 2), 3% in the dorsiplantar surface of the feet (zone 3), and 3% of the subjects having foot blisters in the Achilles tendon of the feet (zone 4) (Table 4). Our study revealed that the type of foot coverage was significantly associated with the number of foot blisters (p-value<0.5), with more distance of walking also being associated with a more significant number of foot blisters (p-value<0.5).

There was no association between an increased risk of foot blisters and underlying diseases such as diabetes mellitus, hypertension, cardiovascular disease, and thyroid dysfunction (p-value>0.05). Women were found to be at a higher risk of developing foot blisters (p-value<0.05). We also found no correlation between the

age and education levels of the subjects and the number of foot blisters (p-value>0.05). Finally, patients with a history of last blister formation were not found to be at a higher risk of blister formation than those without (p-value>0.05).

Table 1: Underlying disease of study`s population

Underlying disease (n=3829)	Frequency (%)
Diabetes Mellitus	256(6.6%)
Hypertension	116 (3.02%)
Smokers	77 (2.01%)
Dyslipidemia	74 (1.93%)
Thyroid dysfunction	36 (0.94%)
Ischemic heart disease	11 (0.28%)

Table 2: The frequency of each number of foot blisters

Number of the foot blisters	Frequency	Percent
1	1379	31.3
2	1617	36.8
3	539	12.3
4	451	10.3
5	174	4
6	125	2.8
7	36	0.8
8	45	1
9	13	0.3
10	12	0.3
11	3	0.1
12	1	0.02
14	1	0.02
20	3	0.1

Table 3: Patients` level of the education

Below Diploma	15%
Diploma	29%
Advanced Diploma	7%
Bachelor's Degree	37%
Master's Degree	11%
Doctoral degree	1%

Table 4: Distribution of the foot blister based on foot zones

Zone	Percentage
1	82.3 %
2	12.2 %
3	2.8 %
4	2.7 %

Discussion

Every year, millions of pilgrims participate in the Arbaeen pilgrimage on foot, covering an approximate 80 km distance from Najaf to Karbala City. However, one common problem that pilgrims may encounter is foot blisters, which can significantly impact the quality of their trip. No comprehensive study has demonstrated the prevalence of foot blisters in Arbaeen pilgrimage pilgrims on foot. The prevalence of foot blisters was reported widely based on the studied populations and methods of the studies. Some authors have reported that 54-86% of long-distance hikers and backpackers experience foot blisters during their journey [12,13]. A study showed that 33% of military trainees in Iraq experienced foot blisters during Operation Iraqi Freedom [14]. Further examination of road runners in Southern Brazil revealed that the most widespread form of injury is the occurrence of blisters, with a prevalence rate of 50% [15]. All athletes developed foot blisters during Racing the Planet, an ultramarathon with a 250 km distance [16]. Many consider foot blisters a minor issue but can potentially lead to infectious lesions if they burst [5]. Blisters on the feet can result in pain, preventing someone from completing a race or journey. Additionally, the need for movement and altered gait can exacerbate existing injuries. Furthermore, they can lead to the overuse of specific joints and result in musculoskeletal injuries [17]. Millions participate in the Arbaeen pilgrimage every year, and the overall burden of foot blisters becomes more important. Given the large number of participants, this issue becomes even more important. Socks are of fundamental importance in controlling the humidity of the feet by conveying heat away from the skin and ensuring proper hydration [18]. Some studies have been conducted to lower foot blister formation in walkers. For instance, Eshter et al. found that hikers who wore wet socks experienced more foot blisters. They suggested that hikers change their socks during long-distance walks to keep their feet dry [19]. Key preventive strategies related to friction include efforts to maintain dry skin and avoid the presence of particulate matter, frequent skin lubrication with high-quality lubricant, assurance of proper shoe fit and break-in, use of soft insoles and properly fitting orthotics, callous removal, proper toenail trimming, reduction of load carriage, use of low friction or double shock layers, and use of low friction coefficient tape or patches applied to the skin or shoe in high-pressure areas [4]. Keeping the feet dry and devoid of any particles, regularly applying high-quality lubricants, wearing correctly fitting shoes, removing calluses, trimming toenails appropriately, reducing the amount of weight being carried, utilizing low-friction socks or double layers, and employing tape or patches with low friction coefficient on areas of high pressure are some effective strategies to minimize friction based to a study [4]. A comprehensive review conducted by Worthing et al. found that although socks, antiperspirants, and barriers are commonly used to prevent friction blisters, a lack of high-quality evidence supports their effectiveness. However, paper tape appears to be a promising form of barrier prevention [20]. Our study found that foot coverage plays a significant role in preventing friction. We did not find similar studies that compared slippers and shoes in this regard. However, in our study, patients with better foot coverage experienced fewer blisters. Friction foot blister formation is commonly related to mechanical factors rather than the underlying disease. Individuals with diabetes often experience impaired blood flow and nerve damage (neuropathy), which can lead to the development of foot ulcers and severe, persistent infections [21]. Smoking cigarettes increases the likelihood of developing diabetic foot ulcers through several pathways. This habit negatively affects blood sugar regulation, enhances the production of advanced glycated end-products, and hastens the progression of peripheral artery disease [22].

Mehrvarz and his colleagues [23] conducted a study to prevent traumatic processes in Arba'een pilgrims. The results showed that, in addition to individual care and the preparation of treatment facilities such as cooling tunnels and suitable resting areas, adequate training in the existing conditions must be provided. Therefore, educating individuals and developing health guidelines that encompass health-related aspects from the beginning of the pilgrimage to the end is essential for preventing these injuries.

According to our findings, cigarette smoking and other underlying diseases are not associated with blister formation. However, evidence suggests that tobacco use could increase the likelihood of developing blisters [4,24]. The research conducted by Damoisy et al. on 533 runners revealed that a history of previous blister formation is a significant risk factor for developing

blisters. Additionally, runners who covered shorter distances had a lower incidence of foot blisters [25]. However, our findings did not reveal any relationship between the occurrence of previous blisters and the formation of new blisters. Similarly, as reported by Damoisy et al., engaging in longer-distance walks was associated with increased foot blisters. No comprehensive study has explored the relationship between underlying disease and the risk of foot blister formation. Despite the lack of identified associations, further research is necessary to uncover any potential associations that may exist.

Conclusion

This study represents the first known investigation of foot blister formation risk during the Arbaeen pilgrimage. In light of these findings, we respectfully advise Arbaeen pilgrims, particularly women, to use suitable footwear and maintain dry feet to mitigate the risk of blister formation. Furthermore, we recommend wearing thick socks, reducing the friction tension on the epidermal surface and ultimately decreasing the likelihood of blister formation.

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Conflict of Interest Disclosures

None.

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Declaration of Generative AI and AI-assisted technologies

None.

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Ethical Statement

The study proposal was approved by the Ethics Committee of Qom University of Medical Sciences (IR.MUQ.REC.1398.008).

References

1. Lami F, Hameed I, Jewad AW, Khader Y, Amiri M. Real-time surveillance of infectious diseases and other health conditions during Iraq's Arbaeenia mass gathering: cross-Sectional Study. JMIR Public Health Surveill. 2019;5(4): e14510.

2. Sims A. Millions of Muslims take Part in Mass Pilgrimage of Arbaeen-in spite of ISIS. Independent Online [available at: http://www independent co uk/news/world/middle-east/20-million-muslims-marchagainst-isis-arbaeen-pilgrimage-iraq-karbalaa7436561 html]. 2016.

3. Krabak BJ, Waite B, Lipman G. Evaluation and treatment of injury and illness in the ultramarathon athlete. Physical Medicine and Rehabilitation Clinics. 2014;25(4):845-63.

4. Hoffman MD. Etiological foundation for practical strategies to prevent Exercise-Related foot blisters. Curr Sports Med Rep. 2016;15(5):330-5.

5. Bush RA, Brodine SK, Shaffer RA. The association of blisters with musculoskeletal injuries in male marine recruits. J Am Podiatr Med Assoc. 2000;90(4):194-8.

6. Van Tiggelen D, Wickes S, Coorevits P, Dumalin M, Witvrouw E. Sock systems to prevent foot blisters and the impact on overuse injuries of the knee joint. Military medicine. 2009;174(2):183-9.

7. Knapik JJ. Prevention of foot blisters. Journal of special operations medicine: a peer reviewed journal for SOF medical professionals. 2014;14(2):95-7.

8. Cortese TA, Fukuyama K, Epstein W, Sulzberger MB. Treatment of friction blisters: an experimental study. Arch Dermatol. 1968;97(6):717-21.

9. Janssen L, Allard NA, Ten Haaf DS, van Romburgh CP, Eijsvogels TM, Hopman MT. First-aid treatment for friction blisters:"Walking into the right direction?". Clinical journal of sport medicine. 2018;28(1):37-42.

10. Hoeffler DF. Friction blisters and cellulitis in a navy recruit population. Military medicine. 1975;140(5):333-7.

11. Taylor C, Riordan F, Graham C. New football boots and toxic shock syndrome. Bmj. 2006;332(7554):1376-8.

12. Twombly SE, Schussman LC. Gender differences in injury and illness rates on wilderness backpacking trips. Wilderness Environ Med. 1995;6(4):363-76.

13. Stewart Anderson Jr L, Rebholz CM, White LF, Mitchell P, Curcio III EP, Feldman JA, et al. The impact of footwear and packweight on injury and illness among long-distance hikers. Wilderness Environ Med. 2009;20(3):250-6.

14. Brennan Jr FH, Jackson CR, Olsen C, Wilson C. Blisters on the battlefield: the prevalence of and factors associated with foot friction blisters during Operation Iraqi Freedom I. Military Medicine. 2012;177(2):157-62.

15. Purim KSM, Leite N. Sports-related dermatoses among road runners in Southern Brazil. A Bras Dermatol. 2014; 89:587-92.

16. Lipman GS, Ellis MA, Lewis EJ, Waite BL, Lissoway J, Chan GK, et al. A prospective randomized blister prevention trial assessing paper tape in endurance distances (Pre-TAPED). Wilderness Environ Med. 2014;25(4):457-61.

17. Lipman GS, Sharp LJ, Christensen M, Phillips C, DiTullio A, Dalton A, et al. Paper tape prevents foot blisters: a randomized prevention trial assessing paper tape in endurance distances II (Pre-TAPED II). Clinical Journal of Sport Medicine. 2016;26(5):362-8.

18. McLellan K, Petrofsky JS, Bains G, Zimmerman G, Prowse M, Lee S. The effects of skin moisture and subcutaneous fat thickness on the ability of the skin to dissipate heat in young and old subjects, with and without diabetes, at three environmental room temperatures. Med Eng Phys. 2009;31(2):165-72.

19. Esther C-L, Gabriel G-N, Raquel S-R, Alfonso M-N. The influence of sock composition on the appearance of foot blisters in hikers. J Tissue Viability. 2022;31(2):315-8.

20. Worthing RM, Percy RL, Joslin JD. Prevention of friction blisters in outdoor pursuits: a systematic review. Wilderness Environ Med. 2017;28(2):139-49.

21. Anders J, Smith S. Developing a resource for people with diabetes about preventing foot problems: research, audit and user insight. J Commun Healthc. 2010;3(3-4):184-96.

22. Bechara N, Hng T-M, Gunton JE. The association between tobacco smoking and systolic toe pressures in active foot ulceration. Sci Rep. 2024;14(1):8550.

23. Mehrvarz S, Ahmadpour F, Kamali SM, Rasouli HR. Preventable Trauma during Arba'een Procession. Trauma Mon. 2024;29(3):1142-7.

24. Reynolds KL, White JS, Knapik JJ, Witt CE, Amoroso PJ. Injuries and risk factors in a 100-mile (161-km) infantry road march. Prev Med. 1999;28(2):167-73.

25. Damoisy J-B, Destombes V, Savina Y, Prцpper CJ, Braun C, Tannй C. Epidemiology, prevention methods, and risk factors of foot blisters in French trail ultramarathons. J Sports Med Phys Fitness. 2023.