Original Article

Impacts of Foot and Body Odor on Quality of Life

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Background: Foot and body odor have been found in some dermatologic diseases such as foot odor in pitted keratosis [PK]. The studies about odors are limited, especially, their impacts on patients' quality of life [QoL].

Objective: To demonstrate the effects of odor on patients' QoL, focusing on foot odor and association between the severity of foot odor and PK.

Materials and Methods: Seven hundred eighty-eight Thai naval rating cadets enrolled in the study. Odor was assessed by questionnaires. The severity of foot odor was evaluated using visual analog scale [VAS] score by the participant's self-determination. QoL was assessed by Dermatology Life Quality Index [DLQI] questionnaire. Physical examination was performed by dermatologists. The association among PK, DLQI total score, and odor were analyzed.

Results: Seven hundred twenty-nine participants (92.5%) completed the questionnaires and physical examination. Foot odor was reported in 309 (42.4%), whereas body odor was found in 140 (19.2%). The mean DLQI total score significantly increased in the participants who had foot or body odor; comparing with those without odor. The positive correlation between DLQI total score and the severity of odor was demonstrated (r = 0.4, *p*-value <0.001). Foot odor significantly affected on patients' QoL defining as DLQI score greater than 6 (*p*-value 0.04), comparing with those reporting no foot odor. Moreover, PK was described in 125 (17.1%) cases in the present study. The median VAS score of foot odor was significantly different between the participants with and without PK (*p*-value 0.002).

Conclusion: The present study demonstrated that odor had significant impact on patients' QoL, using statistical analysis. Severity of unpleasant foot odor was correlated with diagnosis of PK. Thus, physicians should pay attention to this problem and perform a proper management.

Keywords: Odor, Foot odor, Body odor, Pitted keratolysis, Dermatology Life Quality Index [DLQI] questionnaire

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The initial approach to patients presenting with a dermatologic problem requires a detailed history of current skin complaint and complete skin examination. Visual inspection is a major evaluation tool for dermatologic diagnosis, because many skin diseases are diagnosed by characteristic appearances or morphology of lesions. Although the visual sensation plays an important role to recognize skin diseases, sometimes other senses such as sense of smell is beneficial to an early diagnosis. Interestingly, some dermatological conditions in metabolic diseases produce characteristic odors[1]. Bromhidrosis (body odor) is a condition of hyperhidrosis with unpleasant body odor due to overproduction by apocrine glands and bacterial decomposed fatty acids[2]. More than body odor, foot odor is also a serious problem. Pitted keratolysis [PK] is a general foot problem caused by superficial overabundance of bacteria including *Corynebacterium* spp., *Micrococcus sedentarius*, and *Dermophilus congolensis*[3]. Typically, PK presentation is multifocal discrete pitting and superficial erosions at plantar surface of foot due to proteolytic activity of bacteria in stratum corneum. Correlated symptoms are hyperhidrosis, malodor, itching, and irritation. Consequences of secondary bacterial infection are common complications.

In general, PK is predominantly reported in young adult especially for men who wear protective and occlusive footwear by routine work regulation. A prospective study that was performed in South Vietnam reported that the prevalence of PK in volunteer soldiers was 53%[4]. Patients with PK commonly are farmers, athletes, and army personnel, because the predisposing

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factors of PK are related to hyperhidrosis, poor foot hygiene, and excessive humidity in footwear.

Considering that quality of life [QoL] is an important aspect in health[5,6], the present study aimed to demonstrate the effects on patients' QoL caused by body or foot odor and contributes to evaluate the ability of Dermatology Life Quality Index [DLQI] questionnaire to assess the effects of odor and what domains might be associated with a worse QoL. The association among PK, DLQI total score, and odor was analyzed.

Materials and Methods

Study design and population

The present study was a cross-sectional analysis with questionnaire survey and physical examination of 788 Thai naval rating cadets. The cooperation among Naval Medical Department, Royal Thai Navy and Department of Dermatology, Faculty of Medicine Siriraj Hospital, Mahidol University was performed in August 2015. All participants studied and trained in the Thai naval rating school in Chonburi, Thailand. The study was approved by the Siriraj Institutional Review Board, Faculty of Medicine Siriraj Hospital (Si 631/2011). All participants over 18 years of age were included after understanding the objective of the study and signing a term of free and informed consent.

Assessment tools

The questionnaire was composed of two sections. The data including personal activity, daily lifestyle, behaviors and clinical symptoms were assessed in the first part. It composed of 29 items as follows: (i) 17 items of personal data and risk factors of fungal infection, and (ii) 12 items of recognizing signs and symptoms of foot lesions. The severity of unpleasant body and foot odor was determined by visual analog scale [VAS] score. The VAS score is a psychometric response scale that can measure subjective patients' attitudes. The 10-centimeter VAS ranged from a minimum score of 0 (no odor) to a maximum score of 10 (the most severe odor). The second part was the Thai DLQI questionnaire that applied as a general dermatologic disease questionnaire in the aspect of QoL. It has been developed by Finlay and Khan[6]. There are 10 questions consistent with six domains, Symptoms and feeling, Daily activities, Leisure, Work and school, Personal relationships, and Treatment. The DLQI total scores cover between 0 and 30. The higher scores were known to lower QoL. The DLQI total score was classified according to the severity of effect on patient's life as follows: 0 to 1 (no effect at all), 2 to 5 (small effect), 6 to 10 (moderate effect), 11 to 20 (very large effect), and 21 to 30 (extremely large effect)[5]. Dr. Finlay had given formal permission to Dr. Kulthanan to validate and use the Thai version of the DLQI questionnaire[6,7]. The patients completed the DLQI questionnaire after explaining how to fill in the questionnaires. The physical examination was performed and recorded by dermatologists.

Statistical analysis

Statistical analysis of the present study was based on the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) version 23. To assess the number of abnormal clinical presentations including with foot lesions and odor including body and foot odor, descriptive statistic was analyzed and reported as the median score and interquartile range [IQR]. Testing for the association between DLQI total score and abnormal clinical presentations such as odor, Kruskal-Wallis test was applied to demonstrate differences between all groups. The *p*-value of 0.05 or less was considered to be statistically significant.

Results

From the 788 naval rating cadets recruited in the present study, 729 participants (92.5%) completed the questionnaires and physical examination. Therefore, the analysis was carried on 729 participants, 56.4% (411 cases) detected odor as a problem. Foot odor was detected in 309 cases (42.4%), while body odor was a problem in 140 cases (19.2%). Median DLQI total scores of those with body or foot odor was statistically higher then participants without odor [1 (IQR 4) and 0 (IQR 1), *p*-value <0.001]. Additionally, a positive correlation between DLQI total score and the severity of odor assessed by VAS score was found (r = 0.4, *p*-value <0.001). Considering each aspect of the DLQI questionnaire, the odor had a strongly significant impact on three domains of QoL, 1) symptom and feeling, 2) daily activity, and 3) leisure (*p*-value <0.001, <0.001, and <0.001, respectively).

Focusing on foot odor, 309 (42.4%) participants complained about foot odor. The foot odor was significantly associated with DLQI total score (*p*-value <0.001) and correlation between DLQI total score and VAS score of foot odor was present (r = 0.5, *p*-value <0.001). Moreover, the foot odor was significantly associated with the number of DLQI total score greater than 6, which mean moderate effect on patients' QoL (*p*-value 0.04).

More than QoL, the association between foot odor and dermatologic diseases was evaluated in the present study. The foot lesions such as dry scaling or PK were reported in 376 cases (51.6%). PK was described in 125 cases (17.1%) whereas the others were demonstrated as foot eczema in 174 cases (23.9%), tinea pedis in 57 cases (7.8%), and callus or corn in 20 cases (2.7%). Interestingly, foot odor was detected in all cases of PK while it showed in only 75% of patients with tinea pedis. Focusing on PK, the median VAS score of foot odor were reported as 5 (IQR 3) and 4 (IQR 2) in the participants with and without PK, respectively. The significant difference of median VAS score of foot odor between the two groups was demonstrated (*p*-value 0.002).

Discussion

Studies of body or foot odor in dermatology are extremely limited in number, specially to measure of health-related quality of life [HRQoL]. The DLQI is acceptable as a standard measure HRQoL associated with skin disease. It is widely used in practice. However, the psychometric properties of the DLQI still have some difference of opinion because the instrument does not appear to contain the requirements of odor issue. The present study showed statistical analysis about odor, DLQI, and dermatologic diseases. The statistical evidence supported that odor had a moderate impact in patients' QoL. At present, socialization is essential in daily life. The unpleasant body or foot odor has an influence on us, not just psychosocial but in healthcare. In the aspect of QoL, patients always complain about the shame of having an unpleasant odor. It makes them suffer from low self-esteem. The failure to sustain relationship with other people is a significant psychological disturbance. Therefore, dermatologists should pay more attention to early recognition of odor and early treatment to improve patients' QoL. For those reasons, the QoL is an important issue that should be evaluated at every doctor visit.

At present, the DLQI questionnaire is acceptable as the standard measurement of HRQoL in general dermatology[7]. Practically, it is frequently used to evaluate the impact of dermatological conditions on patients' life. The authors' study demonstrated that the DLQI questionnaire is able to achieve and determine the effect of unpleasant odor on patients' life even though the odor issue is not included in each item of DLQI questionnaire. Based on the previous study, there are several limitations of the DLQI questionnaire[8]. Owing to the importance of odor, further studies are needed to develop HRQoL questionnaires of dermatologic diseases to have a complete evaluation in practical use.

In dermatologic diseases, PK is a common disease and is usually diagnosed by clinical presentation. Most patients complain of bad foot odor while the foot with punched-out pits is not recognized. From the present study, we found that the unpleasant foot odor is a key diagnosis of foot skin diseases and can be applied as a clue for PK diagnosis. As mentioned above, the odor is a significant sign of dermatologic disease, as much as the skin lesions. The patients with foot odor require active treatment, and therefore, physicians should not neglect this problem.

What is already known on this topic?

Pitted keratolysis presents by multifocal discrete pitting on plantar surface and malodor. The DLQI questionnaire is acceptable as the standard instrument of QoL associated with skin disease.

What this study adds?

The unpleasant odor had a moderate impact in patients' QoL. Owing to the importance of odor, a specific HRQoL questionnaires should developed for complete evaluation in practical use. The unpleasant foot odor is a clue for diagnosis of PK.

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Potential conflicts of interest

The authors declare no conflict of interest.

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