ISSN: 3032-3134 (ONLINE)
InaJBCS | Indonesian Journal of Biomedicine and Clinical Sciences

The effectiveness of topical vitamin D_3 for dry skin in elderly

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https://doi.org/10.22146/inajbcs.v56i01.11961

Submitted: 2023-04-22
Accepted : 2023-08-12

ABSTRACT

Dry skin is one of the most common dermatoses found in the elderly. Vitamin D is an essential fat-soluble vitamin that has a role in repairing the skin barrier. Topical administration of vitamin D_3 is expected to increase skin hydration in the elderly. Thirty-two participants were divided into two groups, namely 5000 IU vitamin D_3 and the base lotion groups. The assessment was carried out by calculating the *overall dry skin score* (ODS), transepidermal water loss (TEWL), and skin capacitance every four week for twelve week. All groups showed an improvement in ODS, a decrease in TEWL, and an increase in skin capacitance value at the end of the measurement, and no significant side effects were reported. The 5000 IU vitamin D_3 lotion group had the highest level of skin hydration compared to the other group ($p>0.05$). We conclude that the administration of 5000 IU vitamin D_3 lotion may be administrated safely and improve skin hydration in the elderly but is not more effective than base lotion.

ABSTRAK

Kulit kering merupakan salah satu permasalahan kulit yang paling banyak dijumpai pada lanjut usia. Vitamin D merupakan vitamin esensial larut lemak yang memiliki peran dalam memperbaiki sawar kulit. Pemberian topikal vitamin D_3 diharapkan dapat meningkatkan hidrasi kulit pada kulit lanjut usia. Jumlah subjek sebesar 32 lanjut usia dan terbagi ke dalam dua kelompok yaitu kelompok pemberian losion vitamin D_3 5000 IU dan kelompok pemberian losion basis. Penilaian dilakukan dengan melihat *overall dry skin score* (ODS), *transepidermal water loss* (TEWL), dan kapasitansi kulit tiap 4 minggu selama 12 minggu. Seluruh kelompok menunjukkan perbaikan pada skor ODS, penurunan nilai TEWL, dan peningkatan nilai kapasitansi kulit pada akhir penilaian dan tidak ditemukan adanya efek samping. Kelompok pemberian losion vitamin D_3 5000 IU memiliki tingkat kelembapan kulit yang paling tinggi dibandingkan dengan kelompok lainnya ($p>0,05$). Kami menyimpulkan bahwa pemberian losion vitamin D_3 5000 IU dapat diberikan secara aman dan dapat memperbaiki hidrasi kulit pada lanjut usia namun tidak lebih efektif dibandingkan dengan losion basis.

Keywords:
dry skin;
elderly;
topical vitamin D_3;
skin hydration;
trial

INTRODUCTION

According to the United Nations World Population Ageing Report, an elderly is someone aged ≥60 yr, and the population will exceed that of young adults by 2050. Dry skin is a common condition in the elderly, with a prevalence of 29.5-58.3%.[1] The exact cause of dry skin in the elderly has not been completely identified, but several intrinsic and extrinsic mechanisms

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contribute to this issue. A change in keratinocyte proliferation and differentiation, a decrease in skin lipid levels in the epidermis and sebaceous glands, and impaired skin barrier permeability are suggested to be the main causes of dry skin in the elderly. The use of polypharmacy, such as diuretics, anticholesterol, antiandrogen, and cimetidine drugs; the use of strong soaps or cleansers; the use of hot water; and other environmental factors, such as air conditions should also be considered as contributors to dry skin in the elderly. Dry skin is associated with pruritus, which can lead to scratching, secondary infections, and chronic wounds. This situation can certainly interfere with elderly patients' health and quality of life.[1,2]

Vitamin D is an essential fat-soluble vitamin that is synthesized in the skin by exposure to ultraviolet B (UVB) radiation.[3,4] Vitamin D3 is acknowledged to control the proliferation and differentiation of keratinocytes and the formation of the skin permeability barrier. Vitamin D_3 also can improve filaggrin and the natural moisturizing factor (NMF) of the skin. Russell reported that in conditions of low vitamin serum levels, there was a decrease in skin conduction, and topical administration of vitamin D_3 at a dose of 10μg/g cholecalciferol could improve skin conduction, as indicated by an increase of skin hydration.[5] Skin barrier function and skin moisture level can be assessed through clinical evaluation with overall dry skin score (ODS), transepidermal water loss (TEWL) examination, and skin capacitance examination.[6,7] This study was the first to investigate the topical administration of vitamin D_3 with the active ingredient of 7-DHC for dry skin in the elderly in Indonesia.

This study aims to assess the effectiveness of topical supplementation of vitamin D_3 in improving skin hydration in the elderly. This study is expected to enhance clinician understanding of topical administration of vitamin D_3 in improving skin hydration, which can further be used as a therapeutic option in repairing the skin barrier and improving dry skin in the elderly.

MATERIAL AND METHODS

Subjects and design of study

This study was conducted at the Department of Dermatology and Venereology, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada (FMPHN-UGM) from September to December 2021. This study is a double-blind, randomized controlled trial. Randomization was conducted using the simple randomization method to divide the subjects into two groups. The research subjects were elderly with dry skin who were willing to participate in the study and met the inclusion and exclusion criteria. The inclusion criteria included elderly women and men (aged ≥ 60 yr) in

the Yogyakarta City, subjects diagnosed with clinically dry skin based on overall dry skin scores (ODS) with a minimum score of 1, subjects willing to follow research procedures and sign informed consent, and preferably those who can perform daily activities independently. Subject exclusion criteria were elderly who suffered from skin inflammation at the area where the test material would be applied, elderly who had complaints and needed topical therapy in the test area, and elderly who were incompetent and did not have a representative in giving informed consent.

Procedure

Treatment subjects received topical vitamin D_3 with a form of vitamin D_3 lotion containing 5% 7-DHC equivalent to 5000 IU cholecalciferol, while control subjects received base lotion. The skin hydration level was assessed by measuring dry skin score using ODS, transepidermal water loss (TEWL) using Tewameter®, and skin capacitance using Corneometer®. Side effects were assessed based on subjective assessment using the Safety Assessment Scale criteria.

Week 0 examination was conducted to obtain baseline characteristic data, and then subjects underwent a washout period for one week. During the washout period, subjects would receive the same type of body wash and were not allowed to use other topical preparations. Three fingertip units (FTU) of lotion were applied to the left arm twice daily. After applying the lotion, the subject was asked to bask in the sun for 15 min at maximum. Measurement evaluation was carried out at weeks 4, 8, and 12.

The protocol of this study has obtained an ethical clearance letter from the Medical and Health Research Ethics Committee (MHREC) FMPHN-UGM.

Data analysis

Data analysis was performed using Microsoft Excel and SPSS programs.

RESULTS

The research was conducted on 32 subjects of elderly with dry skin who were evenly divided into two groups. All research subjects were able to complete the research process. Based on the data of research subjects' characteristics, the average age of the subjects in all groups was 70.94 ± 5.53 y.o. Gender distribution in all groups showed more female subjects compared to men, with a proportion of 71.9%. The proportion of elderly with systemic diseases including diabetic mellitus, hypertension, and congestive heart failure was 31.3%. Examination of the basic characteristics of the subjects at week 0 showed no significant mean differences in all variables ($p>0.05$), indicating that the initial data of the two groups were homogeneous.

At the end of the measurement, both groups showed a significant decrease in dry skin score (FIGURE 1) and TEWL value (FIGURE 2). Skin capacitance values in both groups increased at week 12 but were not statistically significant (FIGURE 3). FIGURE 4 shows the comparison of the mean difference of each variable in both groups. The improvement in skin hydration appeared to be more prominent in the vitamin D_3 5000 IU lotion group by 9.35±10.76 a.u compared to the base lotion group by 2.93±7.44 a.u ($p>0.05$). No side effects were found in all subjects of both groups.

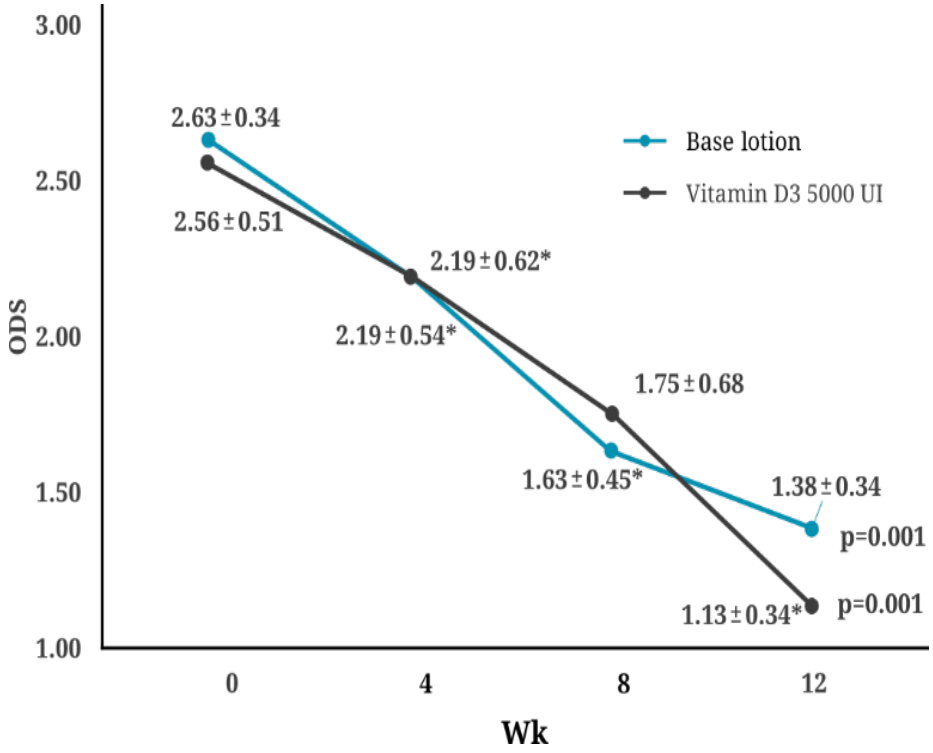

FIGURE 1. The difference in ODS mean scores (week 0 to week 12)

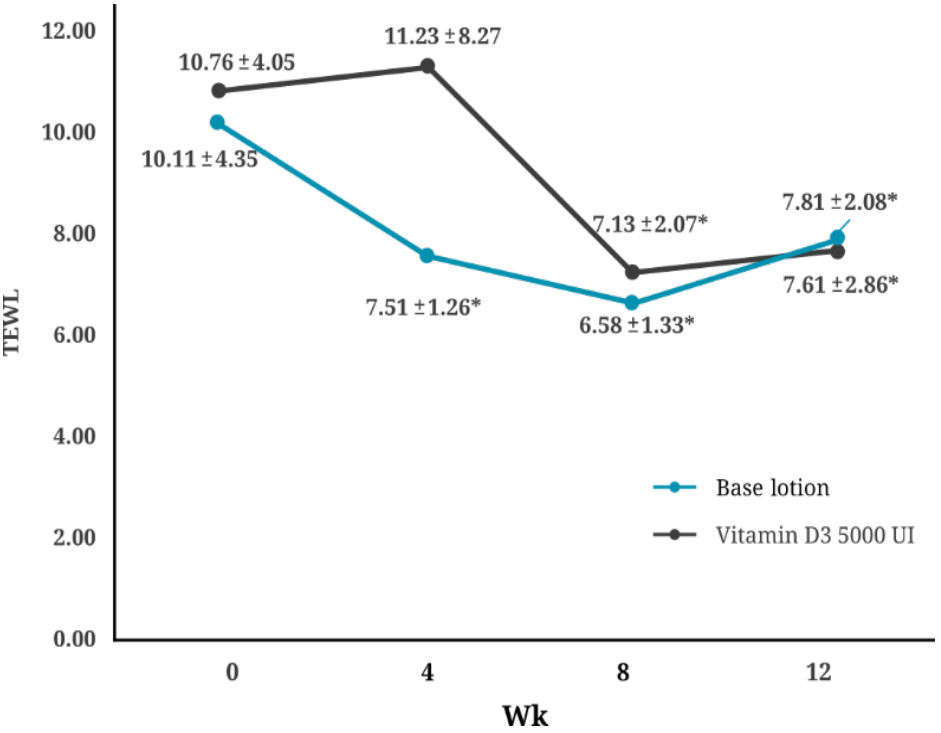

FIGURE 2. The difference in TEWL mean scores (week 0 to week 12)

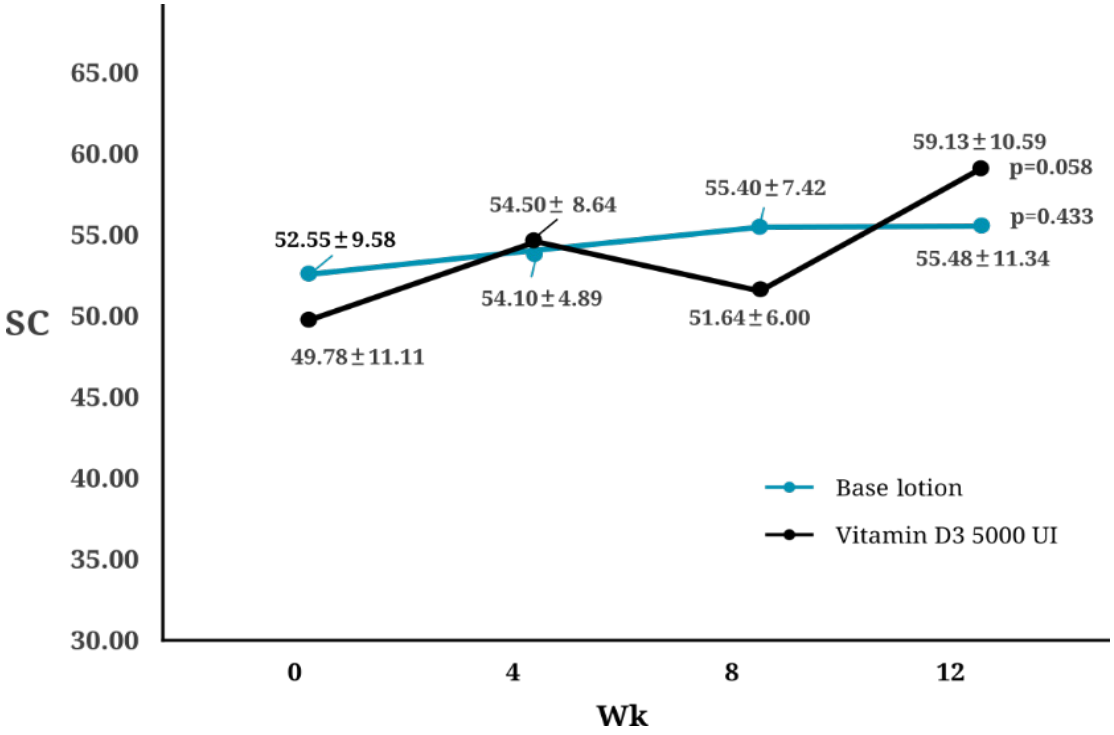

FIGURE 3. The difference in skin capacitance mean scores (week 0 to week 12)

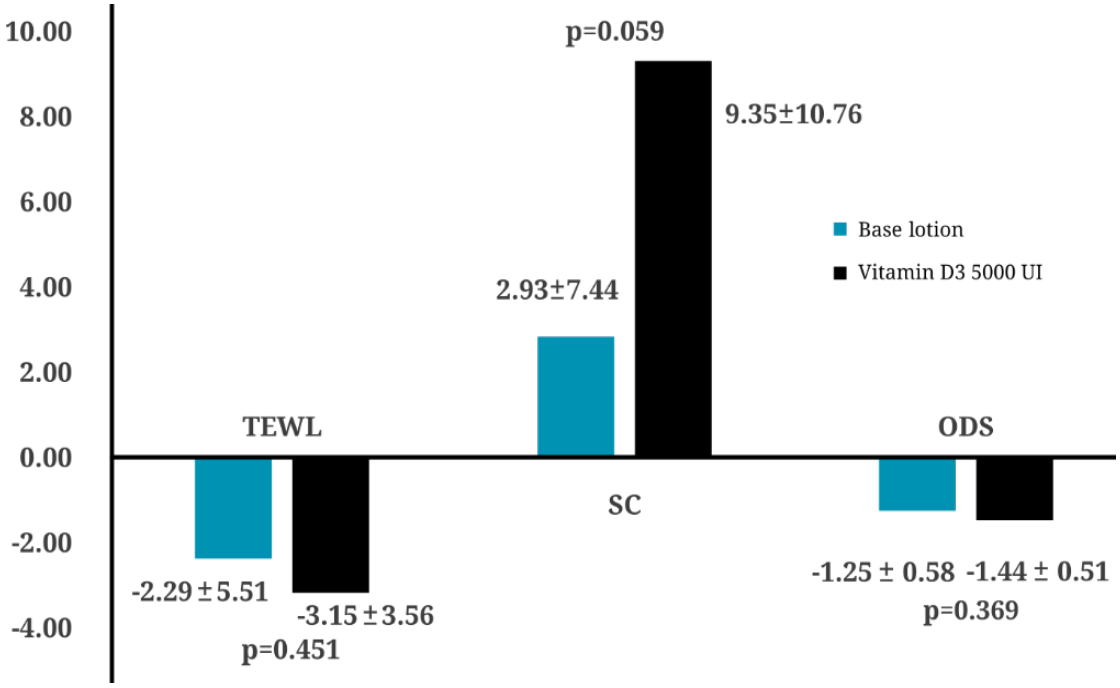

FIGURE 4. The difference in mean changes in TEWL, skin capacitance, and ODS

DISCUSSION

The use of moisturizers is the main therapy for dry skin The target purposes of dry skin treatment include rehydrating the epidermis and improving skin barrier function.[9] The use of moisturizers containing vitamin D_3 for 12 wk was found to be effective in improving skin hydration in the elderly with dry skin. This finding is in line with previous studies on the topical administration of vitamin D_3. Russell reported that there is a link between vitamin serum levels and skin hydration levels. Individuals with lower vitamin serum levels were found to have lower skin hydration levels. Topical supplementation of vitamin D_3 in this study was reported to improve skin hydration and repair dry skin significantly.[5]

Vitamin D_3 in the skin through sun exposure can be converted into its active form, namely 1.25 $(OH)_2D_3$ (calcitriol) with the help of vitamin D-25 hydroxylase (CYP27A) and 25OHD-1-hydroxylase (CYP27B1) enzymes.[10] 1,25 $(OH)_2D_3$ works through the vitamin D receptor (VDR) on keratinocytes.[11] 1,25 $(OH)_2D_3$ has an important role in regulating the proliferation of the basal stratum of the epidermis and triggering keratinocyte differentiation.[12] 1.25(OH)2D3, together with calcium, also plays an important role in increasing the expression of involucrin, transglutaminase, loricrin, and filaggrin and regulates the processing of glucosylceramide long chains that play a role in skin barrier formation.[13]

Aging affects calcitriol production, which drops by 50% due to a decrease in renal function while causing a decrease in calcium absorption by the body. Other effects of aging on vitamin D include a decrease in VDR, a decrease in vitamin D production in the skin, and a deficiency of vitamin D-forming materials. A decrease in the 7-DHC concentration in the epidermis of the elderly led to a 50% decrease in pre-vitamin D_3 formation. Deficiency of substrates or vitamin D-forming materials in the elderly is common. Deficiencies can occur due to poor nutritional intake or lack of sun exposure.[14]

From the study results, it was found that an administration of vitamin D_3 lotion containing 5000 IU was effective in improving the hydration of elderly skin. However, similar results were also found in the base lotion group. It was presumably due to emollient, humectant, and occlusive ingredients in the base lotion. The most concerning complications from topical administration of vitamin D_3 are hypercalcemia and hyperuricemia, but no studies have reported these cases. Hypercalcemia is reported not to occur in patients taking less than 100 g of calcipotriol per week. The most common side effects encountered in topical vitamin D are mild pruritus and irritation, which were not encountered in this study.[15]

Some of the limitations of this study include still involving elderly with a history of chronic diseases and the use of routine medicine because it was difficult to find elderly who were completely healthy or without comorbidities. This condition may also affect the final results of the study. The base lotion also contains emollient, humectant, and occlusive ingredients, so it is better to limit the active ingredients of the base lotion when comparing moisturizers in clinical trials for more precise results.

CONCLUSION

We conclude that the administration of 5000 IU vitamin D_3 lotion is safe to be administered to the elderly and is beneficial in improving dry skin in the elderly. However, the administration of 5000 IU VD3 lotion is not more effective than base lotion.

ACKNOWLEDGEMENT

The authors thank P.T. Dion Farma Abadi for providing Vitamin D3 lotion and base lotion. This study has been supported by a grant from the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia.

The authors thank the staff at Klinik Bahasa, Office of Research and Publication, Faculty of Medicine, Public Health and Nursing Universitas Gadjah Mada, who kindly assisted in proofreading.

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