

Seasonal changes in epidermal ceramides linked to impaired barrier function in acne patients

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Abstract

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- Acne skin demonstrates increased trans-epidermal water loss (TEWL) compared with healthy skin, which may be due, in part, to changes in ceramide levels. We analyzed ceramides in the upper stratum corneum of healthy and acne skin, and studied seasonal variation over the course of a calendar year. Using ultraperformance liquid chromatography with electrospray ionization and tandem mass spectrometry (UPLC/ESI-MS/MS), we identified 283 ceramide species. Acne-affected skin demonstrated overall lower levels of ceramides, with prominent reductions in CER[NH] and CER[AH] ceramides, in addition to the acylceramides CER[EOS] and CER[EOH] that were found to be altered in atopic lesional skin. These differences were more apparent in the winter months and reflected an increase in TEWL in acne skin, compared with healthy skin, which partly resolves in the summer. Individual ceramide species with 18-carbon 6-hydroxysphingosine (H) bases (including CER[N(24)H(18)], CER[N(26)H(18)], CER[A(24)H(18)], CER[A(26)H(18)]) were significantly reduced in acne skin, suggesting that CER[NH] and CER[AH] species may be particularly important in a healthy skin barrier in the face. Moreover insufficient production of these ceramides in acne could contribute to an increase in TEWL.

Figure 1. The SC of acne skin shows reduced levels of CER[NH], CER[AH], CER[EOS] and CER[EOH] ceramides

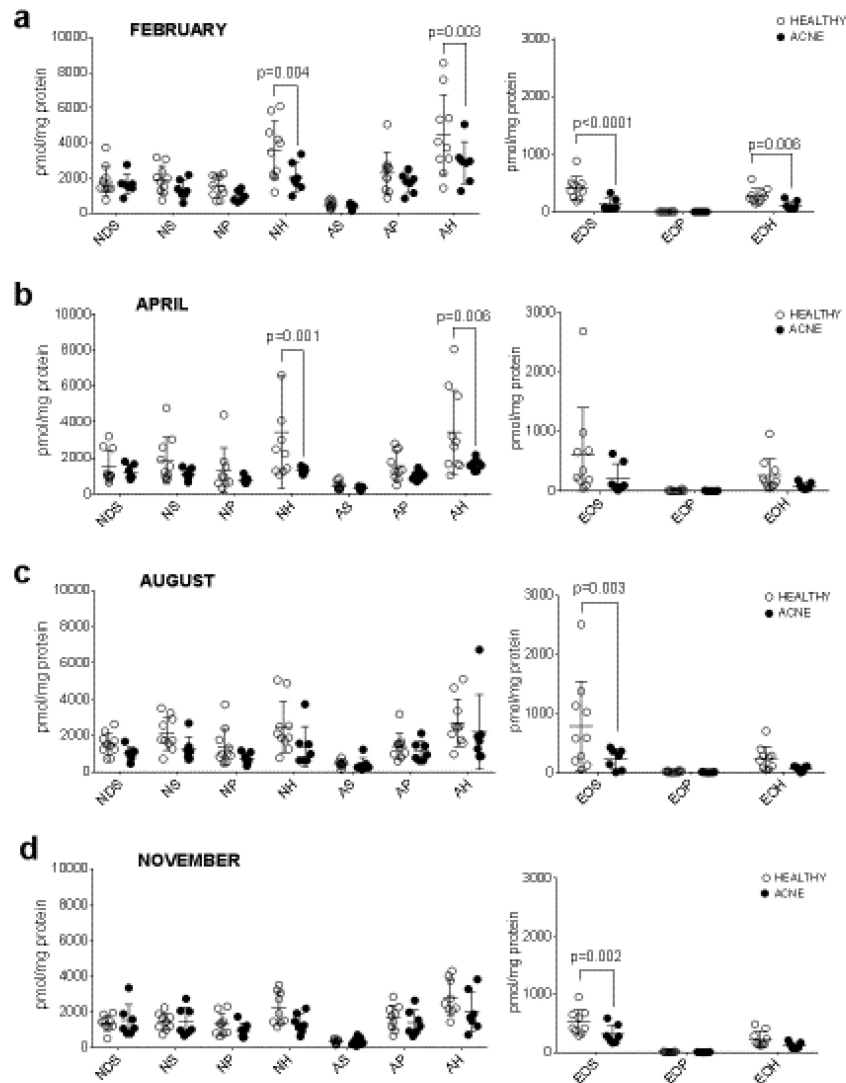


Figure 1. The SC of acne skin shows reduced levels of CER[NH], CER[AH], CER[EOS] and CER[EOH] ceramides. SC lipids were sampled from the cheek skin of adolescent boys with (n=7) and without (n=10) acne in February (a), April (b), August (c) and November (d). Individual ceramide species were analyzed by UPLC/ESI-MS/MS and are presented as total ceramides per family, expressed as pmol/mg protein. In acne, total levels of CER[NH], CER[AH], CER[EOS] and CER[EOH] ceramides were reduced, with differences significant in the winter and spring, and mainly resolving in the summer and autumn. Data are expressed as individual points, lines represent mean \pm SD. Statistical analyses were performed using unpaired *t*-tests corrected for multiple comparisons.

Figure 2. In acne, individual ceramide species containing C18 sphingoid bases within the CER[NH], CER[AH], CER[EOS] and CER[EOH] families demonstrated significant reductions compared with clear skin

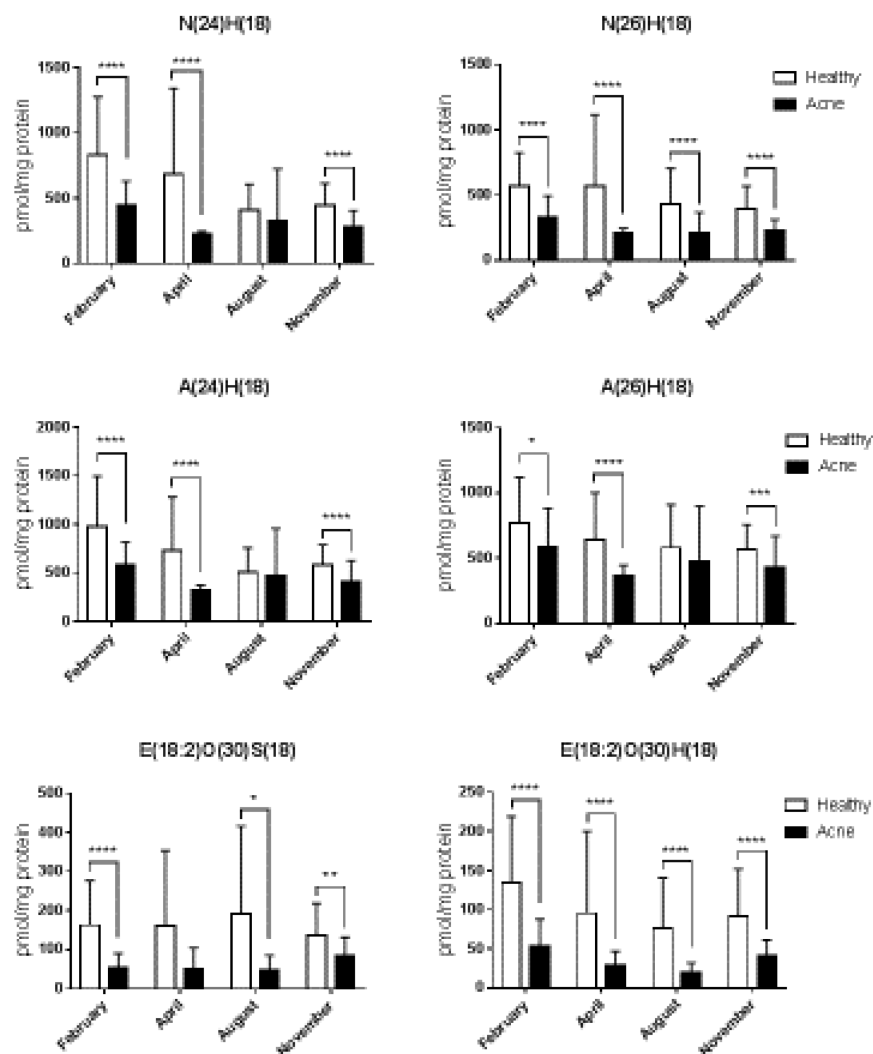
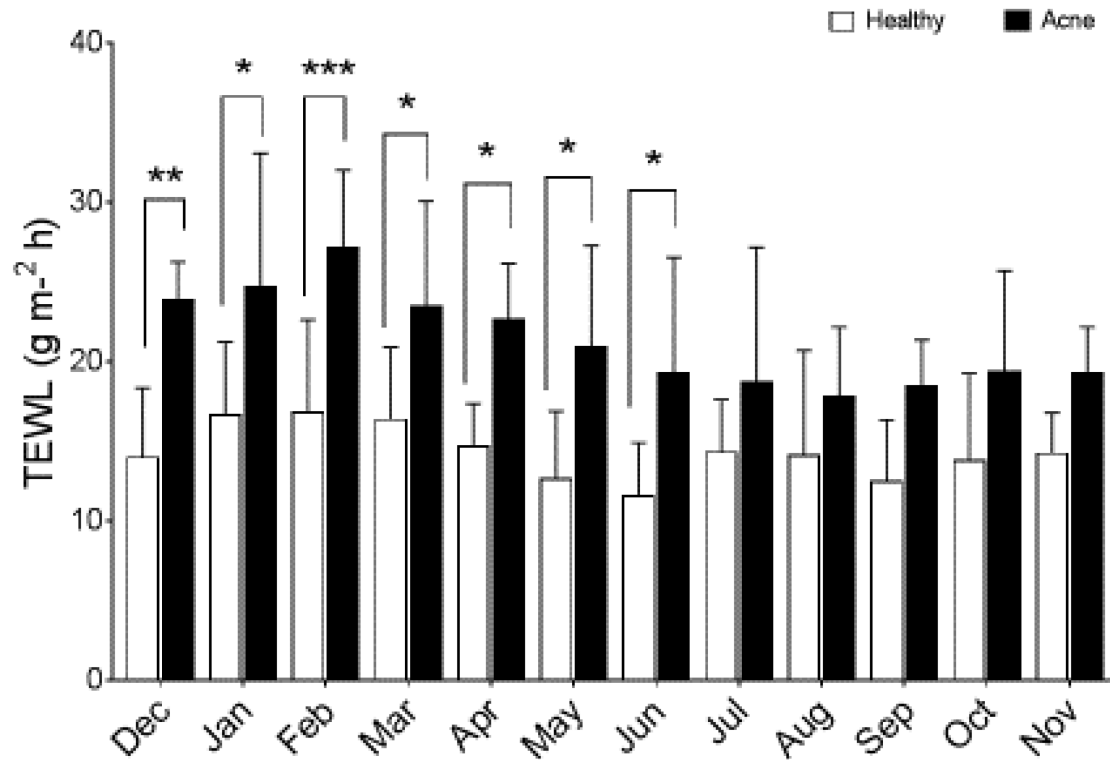


Figure 2. In acne, individual ceramide species containing C18 sphingoid bases within the CER[NH], CER[AH], CER[EOS] and CER[EOH] families demonstrated significant reductions compared with clear skin. Individual ceramide species were analyzed using UPLC/ESI-MS/MS and multiple reaction monitoring, and are expressed as pmol/mg protein. In acne, ceramides CER[N(24)H(18)], CER[N(26)H(18)], CER[A(24)H(18)], CER[A(26)H(18)], CER[E(18:2)O(30)S(18)] and CER[E(18:2)O(30)H(18)] showed reduced expression year-round, although with some improvements in the summer. Data are expressed as mean \pm SD. **** $p < 0.0001$, ** $P < 0.01$, * $P < 0.05$. Statistical analyses were performed using unpaired *t*-tests corrected for multiple comparisons.

Trans-epidermal water loss (TEWL) in clear and acne skin throughout the year



Supplementary Figure 1. Trans-epidermal water loss (TEWL) in clear and acne skin throughout the year. Adolescent boys with (n=7) or without (n=10) acne were assessed for TEWL every month over the course of a year to give an estimation of skin barrier function. Measurements were taken on the cheek after subject acclimation to room conditions, and TEWL was assessed by open-chambered evaporimeter. Acne skin shows increased TEWL compared with clear skin year-round, reaching statistical significance December-June. TEWL is expressed as g m⁻² h, mean ± SD. *P<0.05, **P<0.01, ***P<0.001. Statistical analyses were performed using *t*-tests corrected for multiple comparisons.