Association of Resilience With Depression and Health-Related Quality of Life for Patients With Hidradenitis Suppurativa

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**IMPORTANCE**
Hidradenitis suppurativa (HS) places a significant burden on the health-related quality of life (HRQOL) of patients, many of whom have depression. Resilience can play a role in mitigating the negative stressors, such as the symptoms of HS, on patients’ mental health.

**OBJECTIVE**
To investigate the correlation among resilience, depression, and HRQOL for patients with HS.

**DESIGN, SETTING, AND PARTICIPANTS**
This cross-sectional survey study of 154 patients from 2 referral centers in the United States and in Denmark was conducted from June 1, 2016, to March 31, 2017. Patients were considered eligible if they were 18 years or older and had a visit for HS at 1 of the 2 referral centers in the past 2 years (from January 1, 2014, through December 31, 2016). Patients were excluded if they declined to participate, could not read or write in English or Danish, or had a cognitive disability that would preclude their understanding of the survey questions.

**MAIN OUTCOMES AND MEASURES**
The survey instrument included 4 questionnaires: (1) a sociodemographic and clinical characteristics questionnaire, (2) the Brief Resilient Coping Scale, (3) the Hospital Anxiety and Depression Scale, and (4) the Dermatology Life Quality Index. The main outcome of interest was the HRQOL as measured by the Dermatology Life Quality Index.

**RESULTS**
All 154 patients submitted a completed survey. The mean (SD) age of the participants was 40.93 (13.5) years; most participants were women (130 [84.4%]), and most participants self-identified as white (139 [90.2%]). The rate of depression among the patients in this study was comparable to those reported in previous studies; 55 patients (35.7%) were classified as having depression, and 32 patients (20.8%) had borderline depressive symptoms. Patient-rated HS severity and the depression score each independently estimated 27% and 10% of variation in HRQOL, respectively. The interaction term for resilience and depression was significant, indicating that resilience moderates depression. Analysis of the mediation effects of resilience was not significant, indicating that resilience did not mediate the association between depressive symptoms and HRQOL. The resilience score was significantly associated with depressive symptoms (regression coefficient $\alpha = -0.21; P < .001$), and the depressive symptoms score ($c = 0.637; P < .001$) was significantly associated with lower HRQOL ($c = 0.644; P < .001$). However, both the direct association ($b = 0.033; P = .86$) and the indirect association ($\alpha \times b = 0.007; P = .87$) of resilience with HRQOL were not significant.

**CONCLUSIONS AND RELEVANCE**
Patients with higher resilience levels experienced a smaller decrease in HRQOL as depressive symptoms increased. Because the findings suggest that resilience can be taught, there is an opportunity to develop a resiliency training program and investigate its role in stress levels and depressive symptoms, as well as in HRQOL and disease activity.
Hidradenitis suppurativa (HS) is a chronic, inflammatory skin disease of unknown etiology that causes sudden and persistent eruptions of painful swollen nodules and draining abscesses with disfiguring scars of the skin folds. This condition can make walking, sitting, and working difficult or impossible, and its malodorous drainage is humiliating and uncomfortable. Thus, HS negatively affects patients’ health-related quality of life (HRQOL) and approximately half of patients with HS have a psychiatric comorbidity, most commonly depression.

The association between depression and HS is speculated to be psychosocial or physiological because inflammatory proteins have been associated with symptoms of depression. Specifically, elevated interleukin 6 (IL-6) and IL-8 levels in plasma, serum, and cerebrospinal fluid as well as epidermal growth factor, have been associated with depression. The levels of all 3 of these cytokines can be elevated in patients with HS. More research is needed to understand the pathomechanism of HS and depression, but a strong association remains between depression and worsening health, as has been shown in patients with chronic kidney disease, hypertension, or heart disease. Importantly, a recent study showed that resilience can moderate the association between depression and HRQOL for patients with cardiac disease.

Resilience refers to the ability to successfully adapt to stress and adversity. defined resilience as the “process of effectively negotiating, adapting to, or managing significant sources of stress or trauma.” Resilience has been shown to play a role in mitigating the stressors, such as HS symptoms, contributing to depression. In addition, resilience scores and depression scores have been shown to be inversely related. Thus, given the high prevalence of depression and the adverse association of depression with health, there is a need to investigate if resilience mediates or modifies the correlation between depressive symptoms and HRQOL for patients with HS.

Methods

This international, multicenter, cross-sectional survey study was conducted from June 1, 2016, to March 31, 2017. Two referral sites—Penn State Health Milton S. Hershey Medical Center in Hershey, Pennsylvania, and Zealand University Hospital in Roskilde, Denmark—coordinated to develop an instrument to survey their patients with HS. The instrument included 4 questionnaires: a sociodemographic and clinical characteristics questionnaire, the Brief Resilient Coping Scale (BRCS) (score range: 4-20, with the highest score indicating high resilience), the Hospital Anxiety and Depression Scale (HADS) (score range: 0-21, with a subscore of 11 or greater indicating depression), and the Dermatology Life Quality Index (DLQI) (score range: 0-30, with lower scores typically indicating lower HRQOL). The instrument was built into an online data-collection tool called REDCap. This study was approved by the ethical review boards of the Penn State Health Milton S. Hershey Medical Center and Zealand University Hospital. Implied consent was obtained in the United States. With implied consent, participants read a description of the research, and if they go on to complete any part of the survey, then it is implied that they consented (because they went on to complete the survey); in this form of consent, a consent form is not signed. This also differs from verbal consent because the participant and investigator are never in the same room because the survey was electronic. Written informed consent was obtained in Denmark.

Patients were eligible for inclusion if they were 18 years or older and had a visit for HS at 1 of the referral centers in the past 2 years (from January 1, 2014, through December 31, 2016). Patients were excluded if they declined to participate, could not read or write in English or Danish, or had a cognitive disability that would preclude their understanding of the survey questions. Only patients who submitted a complete survey were included (n = 154); thus, methods for handling missing data were not required.

Measures

Health-Related Quality of Life

The HRQOL of the participants was the outcome of interest or dependent variable in this study. It was assessed using the DLQI, a widely used, validated, skin-specific HRQOL questionnaire comprising 10 items related to symptoms, embarrassment, shopping and home care, clothing, social and leisure activities, work or study, close relationships, sex, and treatment. Each DLQI question asks patients to score the influence of HS on their life over the previous week, and scores range from 0 to 30 points. To facilitate our interpretation, we reverse coded the scores in such a way that lower scores indicated lower HRQOL in the analysis. The score categories were as follows: 29 to 30 points indicate no influence on HRQOL, 25 to 28 points indicate a small influence, 20 to 24 points indicate a moderate influence, 10 to 19 points indicate a very large influence, and 0 to 9 points indicate an extremely large influence. The DLQI in this current sample had a Cronbach α = .90.

Depressive Symptoms

Depressive symptoms of the participants were assessed using the HADS. The HADS is a widely used, validated, 14-item self-assessment of the current anxiety and depressive symptoms of patients. There are 7 independent subscales for anxiety and 7 independent subscales for depression, and scores range...
from 0 to 21 points. Subscores of 11 points or greater in the depression subscale were interpreted as having depression. A score of 8 to 10 points was considered a borderline case. In this analysis, only cases were included. The HADS in this sample had a Cronbach \( \alpha = .88 \).

**Resilience**

Resilience of the participants was assessed using the BRCS. The BRCS questionnaire has 4 items, and scores range from 4 to 20 points. Scores of 4 to 13 were considered low resilience, 14 to 16 were considered moderate, and 17 to 20 were considered high resilience. The BRCS in the current sample had a Cronbach \( \alpha = .74 \).

**Sociodemographic and Clinical Characteristics**

Patients were asked to provide sociodemographic data—age, sex, race/ethnicity, study site, and educational attainment (coded as 1, less than high school diploma; 2, high school diploma or general education development (GED) certificate; 3, some vocational school; 4, associate's degree or some college; 5, bachelor's degree; or 6, graduate degree). In addition, patients self-reported their HS severity at the time of the survey using an 11-point scale ranging from 0 (not severe) to 10 (very severe).

**Statistical Analysis**

Descriptive analyses were performed to describe the characteristics of the study sample. Continuous variables are presented as mean (SD) values, and categorical variables are presented as frequencies and percentages. Continuous variables were centered on the mean of each variable to facilitate interpretation. Next, a series of multiple regressions, which require basic assumptions of linearity, independence, normal distribution, and equal variance, were conducted to determine the squared semipartial correlation of each independent variable, and these correlations were ranked. The Akaike information criterion was used as an estimate of the quality of the regression models, with a lower number indicating better quality. The mediating influence, partial or complete, of resilience on the association between depression and HRQOL was tested using the product of coefficients approach or the Sobel test. The moderating influence of resilience on the association between depression and HRQOL was examined by adding and testing the interaction term in the regression model. A significant interaction term would indicate that resilience moderates the association between depression and HRQOL. To further evaluate the moderating influences, simple slopes were calculated, and significance testing was performed. The Johnson-Neyman technique was used to calculate the values of the moderator for which regression of the dependent variable on the independent variable was significant. Assumptions of linearity, independence, and equal and normal residual variance were evaluated. Points with a Cook distance greater than 0.04 were excluded as outliers. Statistical significance was determined by an alpha level of 0.05 (2-sided \( P = .05 \)). Analyses were performed using R, version 3.3.2 (R Foundation for Statistical Computing).

A power calculation was performed with a sample of 154 participants, a conservative medium effect size of 0.10, in a multiple linear regression model with 8 predictors. This calculation showed the power of 79%.

**Results**

In the United States, 96 patients from the referral centers were invited to participate, 69 (71.8%) of whom responded and 58 (60.4%) of whom submitted complete data. In Denmark, the survey was offered to all patients with HS who visited a specialty clinic for HS. The response rate cannot be calculated, however, because the number of people who viewed and decided not to participate in the survey is unknown. Overall, in Denmark, 126 patients participated, and 96 (76.1%) completed data. The final sample for the study, including patients from the US and Denmark sites, was 154 participants who submitted complete data. The mean (SD) age of the participants was 40.9 (13.5) years; most participants were women (130 [84.4%]), and most participants self-identified as white (139 [90.2%]). Table 1 lists the characteristics of the study sample.

The independent variables with the highest semipartial correlations were HS severity and depression score, with HS severity independently estimating 27% and depressive symptoms estimating 10% of variation in HRQOL (Table 2). For the mediation analysis, resilience score was significantly associated with depressive symptoms score (regression coefficient \( a = −0.21; P < .001 \)), and depressive symptoms score (\( C = 0.637; P < .001 \)) was significantly associated with lower HRQOL (\( c^* = 0.644; P < .001 \)). However, both the direct association (\( b = 0.033; P = .86 \)) and the indirect association (\( a \times b = 0.007; P = .87 \)) of resilience on HRQOL were not significant. These findings indicate that resilience did not mediate the association between depressive symptoms and HRQOL (Figure 1).

For the moderation analysis, HS severity and depression were included in the model along with the interaction term between depression score and resilience score on the basis of the a priori hypothesis of this study. This model estimated a 58% variation in HRQOL and had the lowest Akaike information criterion of the 3 models. The interaction term for resilience and depression was significant and supports the moderation of depression by resilience. The simple slope (SE) for higher levels of resilience (1.5 points above the mean) was 0.56 (0.02) with \( P < .001 \). The simple slope (SE) for lower levels of resilience (1.5 points below the mean) was 0.76 (0.02) with \( P < .001 \) (Figure 2). The moderation of resilience on the simple slope of depression was statistically significant for resilience scores below 19.13 on the BRCS, or 4.62 points above the mean as depicted in Figure 3.

**Discussion**

Depression is a common comorbidity among patients with HS, and our findings support the hypothesis that resilience moderates depression in HS. Depression rates among the patients in this study were comparable to those reported in previous...
studies, suggesting that our findings have general relevance. Compared with healthy controls, patients with HS have been shown to have statistically significant higher rates of depression, which can contribute to impaired HRQOL.\textsuperscript{35,36} Overall, depression rates in the HS population vary in the literature, from as low as 5.9%\textsuperscript{16} to as high as 42.9%\textsuperscript{37} and 48.1%.\textsuperscript{38}

In the present study, 55 patients (35.7%) had HADS scores that were compatible with depression scores found in other studies, and 32 patients (20.7%) had borderline depressive symptoms that were similar to the published prevalence rates.\textsuperscript{5,6,39} Resilience can play an important role in mitigating the negative stressors, such as the symptoms of HS, on patients’ mental health. Without resilience, patients could develop depressive symptoms and even poor physical health as a result of these stressors.\textsuperscript{40} The results of this study indicate that an opportunity exists for an investigation into possible interventions for patients with low levels of resilience because they may be susceptible to depression.

### Table 1. Characteristics of the Study Sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total, No. (%)</th>
<th>Danish Site</th>
<th>US Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>All participants</td>
<td>154 (100)</td>
<td>96 (62.3)</td>
<td>58 (37.7)</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>40.9 (13.5)</td>
<td>41.6 (13.6)</td>
<td>39.8 (13.3)</td>
</tr>
<tr>
<td>Scores on scales</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression symptoms, mean (SD)</td>
<td>8.6 (4.8)</td>
<td>8.1 (4.6)</td>
<td>9.7 (4.8)</td>
</tr>
<tr>
<td>Depression</td>
<td>55 (35.7)</td>
<td>30 (31.3)</td>
<td>25 (43.1)</td>
</tr>
<tr>
<td>Borderline depression</td>
<td>32 (20.8)</td>
<td>21 (21.9)</td>
<td>11 (18.9)</td>
</tr>
<tr>
<td>Resilience, mean (SD)</td>
<td>14.5 (2.7)</td>
<td>14.7 (2.4)</td>
<td>14.5 (2.9)</td>
</tr>
<tr>
<td>HRQOL, mean (SD)\textsuperscript{a}</td>
<td>10.1 (8.6)</td>
<td>12.1 (8.9)</td>
<td>9.2 (7.9)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24 (15.6)</td>
<td>20 (20.8)</td>
<td>4 (6.9)</td>
</tr>
<tr>
<td>Female</td>
<td>130 (84.4)</td>
<td>76 (79.2)</td>
<td>54 (93.1)</td>
</tr>
<tr>
<td>Educational attainment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; High school</td>
<td>14 (9.0)</td>
<td>12 (12.5)</td>
<td>2 (3.5)</td>
</tr>
<tr>
<td>High school diploma or GED certificate</td>
<td>24 (15.6)</td>
<td>9 (9.4)</td>
<td>15 (25.9)</td>
</tr>
<tr>
<td>Vocational school</td>
<td>19 (12.3)</td>
<td>19 (19.8)</td>
<td>0</td>
</tr>
<tr>
<td>Some college or associate's degree</td>
<td>40 (25.9)</td>
<td>19 (19.8)</td>
<td>21 (36.2)</td>
</tr>
<tr>
<td>Bachelor's degree</td>
<td>42 (27.3)</td>
<td>28 (29.2)</td>
<td>14 (24.1)</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>15 (9.7)</td>
<td>9 (9.4)</td>
<td>6 (10.3)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>139 (90.3)</td>
<td>94 (97.9)</td>
<td>45 (77.6)</td>
</tr>
<tr>
<td>Asian</td>
<td>1 (0.6)</td>
<td>1 (1.04)</td>
<td>0</td>
</tr>
<tr>
<td>Black</td>
<td>9 (5.8)</td>
<td>0</td>
<td>9 (15.5)</td>
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<tr>
<td>Hispanic or Latino</td>
<td>3 (1.9)</td>
<td>0</td>
<td>3 (5.2)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (1.3)</td>
<td>1 (1.04)</td>
<td>1 (1.7)</td>
</tr>
</tbody>
</table>

### Table 2. Model of Health-Related Quality of Life, With Ranked Semipartial Correlation of Independent Variables With Model Performance

<table>
<thead>
<tr>
<th>Variable</th>
<th>ΔR\textsuperscript{2}</th>
<th>Rank</th>
<th>b (SE) Model Without Interaction</th>
<th>Model With Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS activity</td>
<td>−0.27</td>
<td>1</td>
<td>−1.73 (0.46)*</td>
<td>−1.70 (0.47)*</td>
</tr>
<tr>
<td>Depression symptoms</td>
<td>−0.10</td>
<td>2</td>
<td>−0.64 (0.17)*</td>
<td>−0.66 (0.11)*</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td>−0.017</td>
<td>3</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Study site</td>
<td>−0.005</td>
<td>4</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Sex</td>
<td>−0.004</td>
<td>5</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Resilience</td>
<td>−0.004</td>
<td>5</td>
<td>−0.03 (0.19)</td>
<td>−0.11 (0.19)</td>
</tr>
<tr>
<td>Education</td>
<td>−0.003</td>
<td>7</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Age</td>
<td>0.001</td>
<td>8</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Depressive symptoms × resilience (interaction term)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0.07*</td>
</tr>
<tr>
<td>Full model $R^2$</td>
<td>0.54</td>
<td>NA</td>
<td>0.56</td>
<td>0.58</td>
</tr>
<tr>
<td>Full model adjusted $R^2$</td>
<td>0.52</td>
<td>NA</td>
<td>0.55</td>
<td>0.56</td>
</tr>
<tr>
<td>Full model AIC</td>
<td>994.08</td>
<td>NA</td>
<td>957.72</td>
<td>955.28</td>
</tr>
</tbody>
</table>

Abbreviations: GED, general education development; HRQOL, health-related quality of life.

\textsuperscript{a}Scores were reverse coded; thus, lower scores indicated lower QOL; scores before reverse coding had a mean (SD) of 19.86 (8.62).
Resilience and Depression in Patients With Hidradenitis Suppurativa

Figure 1. Mediation Analysis of the Association of Resilience With Depression and Health-Related Quality of Life (HRQOL)

The parameter estimates, b (SE; P value), are presented for the association of depressive symptoms with resilience (a = −0.21), the association of resilience with HRQOL after adjustment for depressive symptoms and hidradenitis suppurativa (HS) severity (b = 0.033), the association of depressive symptoms with HRQOL after adjustment for HS severity (c = 0.637), and the direct association between depressive symptoms with HRQOL after adjustment for resilience and HS severity (c′ = 0.644).

Figure 2. Simple Slopes of the Moderation of Depressive Symptoms by Resilience on Health-Related Quality of Life (HRQOL)

Participants with low levels of resilience had a larger positive slope, indicating a larger decrease in HRQOL score for each unit increase in depressive symptoms score. In contrast, participants with high levels of resilience had a more shallow slope, indicating that as the depressive symptoms score increased, the decrease in HRQOL was lower. The areas of statistical significance of those where the 95% CIs (rectangular areas) do not overlap with 0 on the y-axis. Thus, only resilience levels higher than 4.62 points above the mean are not significant. Scores are centered on the mean.

Studies suggest that resilience is a modifiable construct and not a fixed trait in people. Thus, there is the potential for patients to learn resiliency, and research on resiliency training is growing. Current guidelines for the management of HS recommend adjuvant therapy, which may include a broad range of psychosocial support measures. Resilience training may be a useful form of adjuvant therapy in HS. A systematic review and meta-analysis of the efficacy of resilience training programs demonstrated that they led to improvement in resilience, nearly significant improvement in HRQOL, and decreases in depressive symptoms and stress levels. The resiliency training programs reviewed included online videos, self-guided books or readings, telephone calls with individuals or groups, in-person small group sessions with exercises and discussions, or a combination of these methods. These interventions aimed to enhance individuals’ sense of self-efficacy or agency to make a positive change in their condition, handle a variety of situations, and gain control of their lives. These aspects contribute to the well-being of dermatological patients and present an opportunity for further research into dermatological conditions, such as HS, in which resiliency may be relevant. In particular, investigations of the use of resiliency training programs to mitigate stress with symptoms of depression appear interesting because such programs may well improve HRQOL in both the short term and the long term.

Limitations
There are limitations to this study. First, the data were collected through a self-administered and self-reported survey. Second, disease activity was self-reported by patients, and no clinical measures for disease activity were used. Third, the sample size was limited to patients who provided complete data, leaving out those who skipped questions or submitted incomplete responses.

Conclusions
The results of this study support the hypothesis that resilience moderates depression in patients with HS. Participants with higher resilience scores experienced a smaller decrease in HRQOL as depressive symptoms increased. This finding may have clinical implications because resilience can be learned, and thus it presents an opportunity for patients to increase their resilience and for researchers to investigate new options for mitigating the burdens of HS. Adjuvant therapy is recommended by the current guidelines for managing HS; such therapy may include a broad range of psychosocial support measures. Resilience training may be a useful form of adjuvant therapy in HS.
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Author Contributions: Dr Kirby and Ms Butt contributed equally and are co-first authors. Dr Kirby and Ms Butt had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Kirby, Esmann, Jemec.
Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Kirby, Butt, Esmann.
Critical revision of the manuscript for important intellectual content: Esmann, Jemec.

Statistical analysis: Kirby.

Obtained funding: Jemec.
Administrative, technical, or material support: All authors.

Study supervision: Kirby, Jemec.

Conflicts of Interest Disclosures: None reported.

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**NOTABLE NOTES**

**Rona McLeod MacKie, MD, FRCP, FRCPath—A Trendsetter in the Field of Melanoma**

Neeraj Ramakrishnan, BA; Anshum Sood, BS; Stephanie Steinweg, MD

Rona McLeod MacKie, MD, FRCP, FRCPath, was born in Dundee, Scotland, in 1940. She was exposed to an academic lifestyle at an early age through her father, a biochemistry professor at Glasgow University. Later on, she earned her medical degree from Glasgow University.1 A particularly influential moment in Dr MacKie’s career was when she met her first patient with melanoma, a Pakistani man with an ulcerated acral melanoma. The concept of surgically treating the patient’s condition, something which stumped even Dr MacKie’s senior colleagues, sparked her passion for melanoma treatment and motivated her to devote her career to the field of dermatology.2

One of Dr MacKie’s most influential contributions to the field of dermatology was the development of a 7-point checklist to diagnose early invasive malignant melanomas.3 The thickness of a melanoma at the time of diagnosis is key to determining a patient’s prognosis. In addition, the checklist became an integral part of an algorithm used by general practitioners to identify melanomas in their early stages. The checklist measures various features of a skin lesion, including size, irregular pigmentation, irregular border, inflammation, itching or altered sensation, size relative to other lesions, and oozing or crusting. The list was eventually modified so that major lesion features, such as change in size, were assigned 2 points, while minor features, such as inflammation, were assigned 1 point. A score of 3 or more points warrants a referral to a dermatologist.3

Despite the fact that the checklist was developed in the 1980s, it continues to be widely used today and has improved the survival rates of patients with melanoma.1

Besides her pivotal work in the diagnosis and treatment of melanoma, Dr MacKie has also been an influential member of the medical community as a whole. She became a public health advocate in her community by allying with the British Antarctic Survey to educate dermatologists about the potential health problems that occur as a result of ozone depletion. In addition, through holding positions such as editor of the *British Journal of Dermatology*, president of the British Association of Dermatologists, and founder of the Academy of Medical Sciences, Dr MacKie has furthered the dissemination of medical science in a variety of avenues. Outside of her medical career, Dr MacKie enjoys serving on the board of the Scottish Opera and skiing with her grandchildren.1

Overall, Dr MacKie’s many contributions have greatly advanced the field of dermatology. The techniques that she developed to detect invasive malignant melanomas at an early stage have led to earlier diagnosis and treatment of patients with melanoma. Currently, Dr MacKie continues to pursue her passion by conducting research as a Senior Research Fellow in the Faculty of Medicine at the University of Glasgow.1

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