Dermatol Ther (Heidelb) (2023) 13:285–298
https://doi.org/10.1007/s13555-022-00864-1

ORIGINAL RESEARCH

The Association of Alopecia Areata-Related Emotional Symptoms with Work Productivity and Daily Activity Among Patients with Alopecia Areata

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Received: September 19, 2022 / Accepted: November 16, 2022 / Published online: December 9, 2022

ABSTRACT

Introduction: Patients with alopecia areata (AA) experience psychological and psychosocial symptoms including depression, anxiety, anger, social withdrawal, embarrassment, and low self-esteem. While multiple studies have measured the detrimental emotional impact of AA on patient quality of life, evidence of its effect on work productivity loss (WPL) and daily activities is limited. This study aimed to assess the extent of AA-related emotional symptom (ES) burden on work productivity and activity impairment.

Methods: A cross-sectional survey of dermatologists and their adult patients with AA was conducted in the USA in 2019. Dermatologists provided assessments of patients' clinical characteristics, while patients completed sociodemographic questionnaires along with two validated patient-reported outcome measures of the Work Productivity and Activity Impairment (WPAI) and the AA Patient Priority Outcomes (AAPPO) ES subscale. The WPAI assessed AA-related WPL (employed respondents) and activity impairment (all respondents), and the AAPPO-ES assessed AA-related frequency of feeling self-conscious, embarrassed, sad, or frustrated. Multiple linear regression models were fitted to both WPAI scores with the AAPPO ES as an independent variable.

Results: A total of 242 patients with a mean (SD) age of 39.2 (13.3) years, treated by 59 dermatologists, were evaluated. Mean (SD) ES score was 2.0 (1.1). Mean (SD) work productivity loss [n = 170] and activity impairment [n = 242] were 12.2% (17.4%) and 13.3% (18.3%), respectively. After adjusting for covariates, WPL increased by 4.1% [95% confidence interval (CI) 1.6–6.7%; p = 0.002] and activity impairment increased by 3.1% (95% CI 0.7–5.4%; p = 0.010) for every 1-point increase in ES. For an average patient, a 1-SD decrease (about 1 point) on the ES scale substantially reduced WPL and activity impairment (by at least 25%).

Conclusions: Patients with AA reported significant increases in WPL and activity impairment associated with worsening AA-related ES. These findings underscore the substantial emotional

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s13555-022-00864-1.

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and psychosocial burden among patients with AA and a need for improved treatment options.

Keywords: Activity impairment; Alopecia areata; Alopecia areata patient priority outcomes; Emotional symptoms; Psychodermatology; Work productivity loss

Key Summary Points

Why carry out this study?

Patients with alopecia areata (AA) have significant emotional and psychosocial burden, which can reduce their quality of life and work productivity.

This study evaluates the effects of AA-related emotional symptoms on patients' work productivity and activity impairment.

What was learned from the study?

Increases in AA-related emotional symptoms are associated with reduced work productivity and increased activity impairment.

The study shows the magnitude of adjusted effects of emotional symptoms on patients' work productivity and highlights the need for new therapeutics to improve clinical outcomes, leading to potentially improved productivity and emotional symptoms.

INTRODUCTION

Alopecia areata (AA) is an autoimmune disease characterized by nonscarring or complete scalp hair loss (i.e., alopecia totalis, AT) or a complete loss of scalp, facial, and body hair (i.e., alopecia universalis, AU) [1, 2]. The estimated worldwide prevalence of AA is approximately 1 in 1000 individuals, with a lifetime risk of approximately 2% [3]. Both children and adults may develop this condition, with similar rates among male and female individuals [4].

Patients with AA may be adversely affected by psychological and psychosocial symptoms such as depression, anxiety, anger, social withdrawal, embarrassment, and low self-esteem [5, 6]. The reported lifetime prevalence of psychiatric disorders is 66–74% among patients with AA, with a prevalence of depression and generalized anxiety disorder at 38–39% and 39–62%, respectively [3]. Among patients with AA, the incidence of major depression (8.8%) and generalized anxiety (18.2%) is markedly greater than reported in the general population (1.3–1.5% and 2.5%, respectively) [7]. The prevalence of alexithymia, an inability to identify or describe emotions that is considered to be closely related to depression and aggression, has been also reported in 23–50% of patients with AA [7]. Further, patients with AA experience impairment in health-related quality of life (HRQoL) in many other areas, such as personality, behavior, emotions, and social functioning. A multitude of studies have evaluated HRQoL of patients with AA [7–13].

Although the emotional and psychosocial burden of AA as well as its impacts on HRQoL are well established, limited evidence is available to further assess the effect of AA-related emotional symptoms (ES) on work productivity and daily activities. A cross-sectional survey of 216 patients with AA (including 132 employed patients) in the USA found that 45% of the employed AA patients had missed time from work due to AA [14]. However, this online patient-reported study neither used any validated instruments for work productivity loss (WPL) or activity impairment nor fully characterized the patients' AA history [14], which may undermine the true impact of AA extent, especially AA-related ES, on work productivity. Hence, in this real-world data study, we sought to examine the extent of AA-related ES burden on work productivity and activity impairment among patients with AA using two validated instruments—the Work Productivity and Activity Impairment (WPAI) and the AA Patient Priority Outcomes emotional symptoms (AAPPO ES) subscale [15–18].

METHODS

Study Design

A cross-sectional survey of US dermatologists and their adult patients diagnosed with AA was conducted in 2019 using the Adelphi AA Disease Specific Programme (DSP) [19]. DSPs are large, multinational, point-in-time surveys conducted in real-world clinical practice capturing retrospective medical record data, physician survey data, and patient-reported outcomes related to current disease management, disease burden, and associated treatment effects [20, 21]. Dermatologists recruited to the survey were actively involved in treating patients with AA, with a minimum monthly workload of five patients (including one patient with mild AA and four patients with moderate/severe AA, including at least one severe patient, based on the assessment of AA severity by the dermatologists).

Patients were recruited consecutively from a prospective AA patient pool until the severity quota described earlier had been reached. Patients with exclusively AA barbae (i.e., beard facial hair loss) disease type were excluded a priori from this analysis due to their likely different clinical manifestations and patient characteristics [22, 23].

Data Collection

Data were collected using (1) the Patient Record Form (PRF) completed by the dermatologists and (2) patient-reported data collected using the Patient Self-Completion (PSC) questionnaire that included patient-reported outcomes (PROs).

Dermatologist-Reported Data Using PRF

This included information on patient demographics, body mass index (BMI), comorbid conditions, and disease-related variables such as percentage scalp and body hair loss (HL), diagnosis and type of AA, disease history, symptoms, severity, and progression.

At the time of survey, severity of the disease was collected from both the dermatologists and the patients and was categorized as mild, moderate, or severe AA. Given that these agreed 73% of the time, we defined severity using the dermatologist rating.

Patient-Reported Data Using PSC Questionnaire

This included sociodemographic characteristics, treatment history, and economic burden along with two validated PRO questionnaires: the WPAI and the AAPPO, including AAPPO ES subscale. Patients with the complete WPAI and AAPPO ES data were included in the analysis.

Work Productivity and Activity Impairment (WPAI)

The WPAI is a validated instrument [15] that was used to assess AA-related WPL (employed respondents only) and activity impairment (all respondents) over the past 7 days. The specific health problem version of WPAI included six questions and yielded four scale scores: absenteeism (work time missed), presenteeism (impairment at work), WPL, and activity impairment.

Total WPL was calculated combining two scores—absenteeism and presenteeism—wherein absenteeism was the percentage of time missed from work due to AA and presenteeism was the percentage of reduced productivity due to AA while at work. Activity impairment was the percentage of patient-reported impact of AA on productivity in regular unpaid activities. All four scales were scored from 0% to 100%, with higher scores indicating worse work productivity and activity impairment [16].

Alopecia Areata Patient Priority Outcomes Emotional Symptoms (AAPPO ES) Subscale

The AAPPO is a psychometrically validated AA-specific assessment of HL severity, symptoms, and impact on patients with AA [17, 18]. This study only reports on the AAPPO ES subscale that measures AA-related emotional symptoms because detailed data on HL were collected in the PRF and the PSC questionnaires, while activity impairment was covered in the WPAI.

The four items of AAPPO ES (i.e., feeling self-conscious, embarrassed, sad, or frustrated) over the past week were collected on a 5-point scale ranging from "never" to "always." Higher scores on the scales indicated worse outcomes. Scales were scored if at least half the items were completed.

Statistical Analysis

Data were summarized using descriptive statistics [number of subjects (n), mean, standard deviation (SD)] for continuous variables, and frequency and percentage for categorical variables. WPAI scores and AAPPO ES scores were summarized by AA severity levels to assess the AA-related burden by severity.

The association between AAPPO ES and other covariates with WPAI WPL and activity impairment scores was examined. Pearson correlations were calculated between the scores for continuous covariates and the mean (SD) of the scores for categorical covariates. Significance of these associations was calculated using the Pearson correlation p-value for continuous variables and ANOVA F-tests for categorical variables.

Multiple linear regression models were fitted to both WPAI scores, with AAPPO ES as an independent variable and adjusting for other covariates selected from a pool of factors including patient sociodemographics, patient attitudes, AA disease characteristics and history, concomitant conditions, and treatment history. Factors significantly associated ($p < 0.05$) with the WPAI score of interest in bivariate analyses were considered in the modeling to limit multicollinearity and overfitting given the small sample size of the study. Selection of covariates was performed using the forward variable selection procedure with a significance level of $p < 0.05$ selection criterion. Overall fit of models was assessed using the coefficient of determination (R^2). Point estimates for slopes along with 95% CI and two-sided test p-values were reported for the AAPPO ES effect on the outcomes. To facilitate comparisons and interpretation of the effects found, the estimated change in outcomes per 1-SD change in the AAPPO ES scale was also reported.

The design of the study allowed us to assess the patient survey response bias since dermatologist-reported data were available for all patients (i.e., for those who completed PSC questionnaire and for those who did not complete PSC questionnaire). Items in the dermatologist survey were compared between these two groups and tested using two-sample t-tests for continuous variables and chi-squared tests for categorical variables.

Given the low rate of missing values reported for these data, there was no plan to impute missing values. All statistical tests were two-sided, and p-values ≤ 0.05 were considered statistically significant unless otherwise specified and were not adjusted for multiple testing. Analyses were performed using SAS version 9.4.

Compliance with Ethics Guidelines

Institutional review board (IRB) exemption for the study was granted by the Western IRB. Personal identifiable information was not collected, and all responses were anonymized. Patients provided written informed consent through the survey portal for the use of their anonymized and aggregated data for research and publication purposes. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

RESULTS

A total of 242 patients with AA (response rate of 53.5%) treated by 59 dermatologists and who completed PSC questionnaire were included in the analysis (Fig. 1). The mean (SD) age of these patients was 39.2 (13.3) years and time since AA diagnosis was 5.1 (8.4) years. A total of 51% of the patients were female, 81% were white, and 77% were employed at the time of the survey. Additionally, 25% of the patients had other autoimmune comorbidities and 13% had a concomitant mental health condition. According to dermatologist-determined severity, 22%

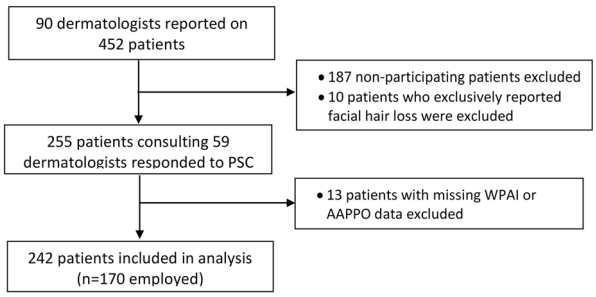

Fig. 1 Flow of Selection of Study Cohort. *AAPPO* Alopecia Areata Patient Priority Outcome, *PSC* patient self-completion questionnaire, *WPAI* Work Productivity and Activity Impairment

of patients had mild AA, 53% had moderate disease, and 25% had severe AA. Patient with AA subtypes were categorized into 17% monolocularis, 77% multilocularis/diffuse/ophiasis, and 6% totalis/universalis.

Results from univariate and bivariate analyses performed among 170 patients with AA who were employed at the time of survey revealed a mean (SD) WPL due to AA of 12.2% (17.4%), which was primarily driven by presenteeism (i.e., lost hours while at work) with a mean (SD) of 10.5% (16.1%). In contrast, absenteeism (i.e., work time missed) had minimal impact on the WPL due to AA (Fig. 2). Additionally, 242 patients reported a mean (SD) impairment of 13.3% (18.3%) in their ability to perform regular daily activities other than work at a job.

Mean (SD) AAPPO ES score for all patients with AA ($n = 242$) was 2.0 (1.1). With the exception of absenteeism, correlations between WPAI scores and AAPPO ES were statistically significant and ranged from 0.21 to 0.29. (Fig. 3).

Correlation: The distribution and association of other factors of interest with the WPAI scores were assessed and presented for factors with significant association (Table 1). For instance, of the overall patient sample (activity impairment $n = 242$), 48.8% were male and

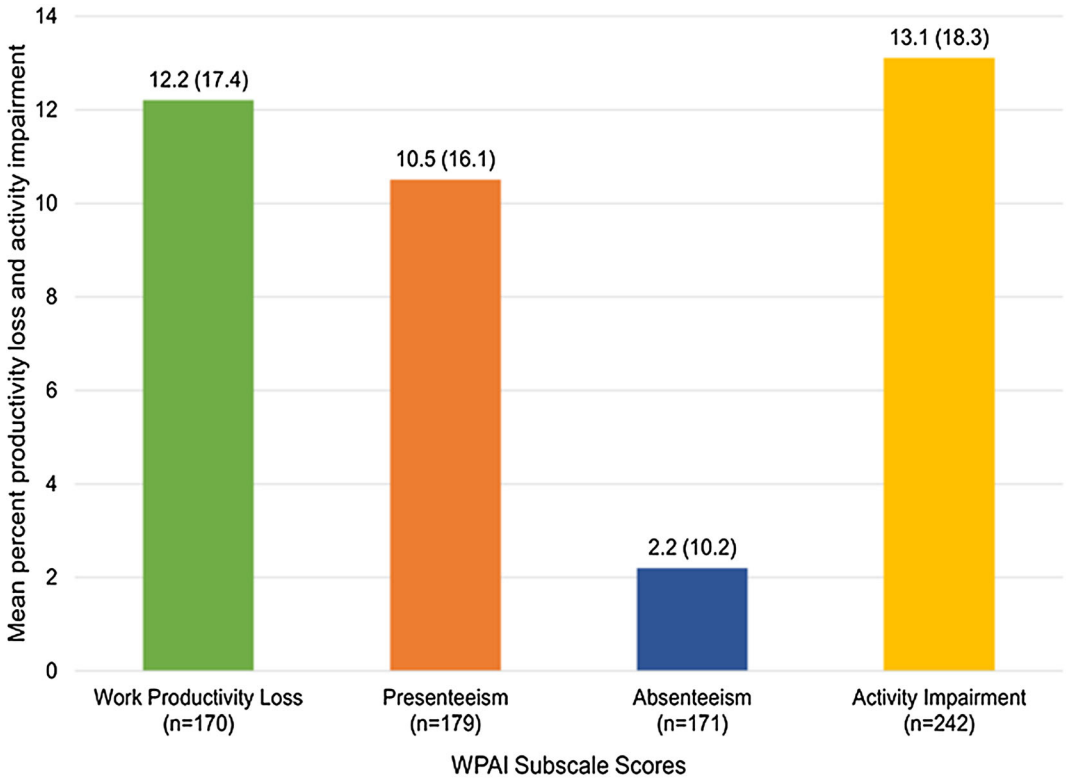

Fig. 2 WPAI Scores—Descriptive Summaries. Values on top of bars indicate mean (SD). *SD* standard deviation, *WPAI* Work Productivity and Activity Impairment

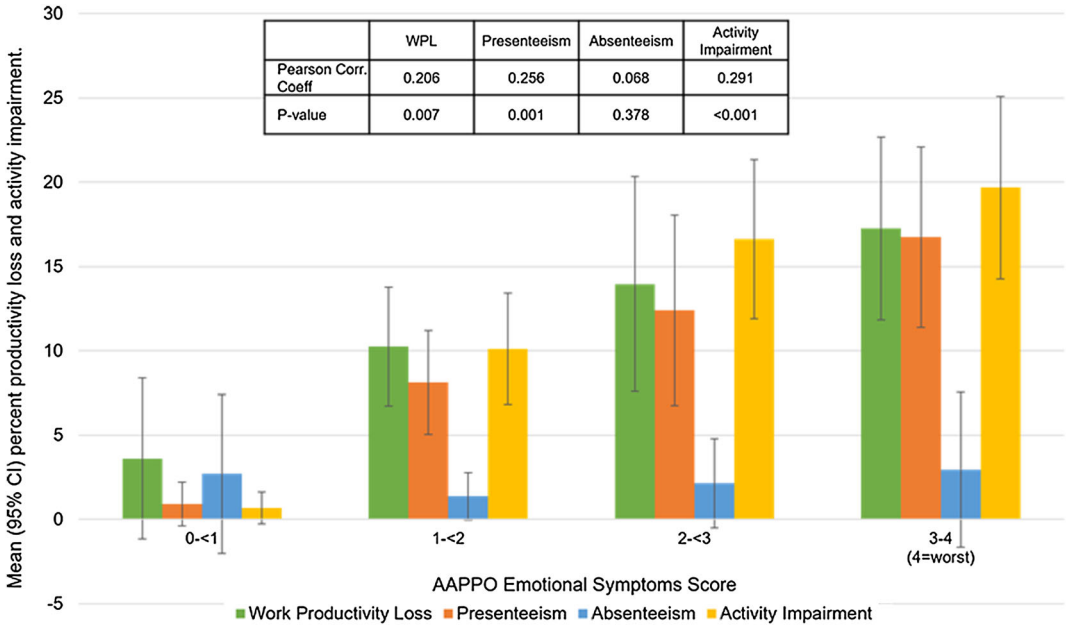

Fig. 3 WPAI by AAPPO Emotional Symptoms Score. The continuous AAPPO ES scores were grouped for presentation purposes. *95% CI* 95% confidence interval, *AAPPO* Alopecia Areata Patient Priority Outcomes, *Corr. Coeff* corrected coefficient, *ES* emotional symptoms, *WPAI* Work Productivity and Activity Impairment, *WPL* work productivity loss

their mean (SD) activity impairment of 10.8% (16.5) was statistically significantly lower compared with that of females at 15.6% (19.7).

Forward Selection: In the stepwise forward selection, significant factors were added, including patient demographics, AA disease characteristics and history, and AA economic burden. Since absenteeism was not impacted by AA, only WPL and activity impairment were considered in the subsequent analyses. Similarly, age, race/ethnicity, and BMI were not associated with the WPAI scores.

Multiple Regression: Analysis showed that after adjusting for covariates including AA severity, disease progression, and affected body parts in the models, WPL increased by 4.1% (95% CI 1.6–6.7%; $p = 0.002$) and activity impairment increased by 3.1% (95% CI 0.7–5.4%; $p = 0.010$) for every 1-point increase (worsening) in ES (Table 2). For a patient with average impairments (WPL 12.2% and activity impairment 13.3%), a 1-SD decrease on the ES scale improved WPL and activity impairment by 37% and 25%, respectively. The *R*-squared estimates indicated a moderate proportion of variance explained in both WPL and activity impairment.

Selection Bias: By examining dermatologists' reports on their patients with AA, we found statistically significant differences between patients who completed PSC (survey participating group) versus those who did not (non-participating group). Both participating and non-participating patient groups were similar with respect to demographics, percent of HL variables, duration of disease, AA type, AA severity, treatment history, and current treatment satisfaction. However, on average, participating patients had lower levels of AA impairment, higher levels of involvement in the treatment decision, and concerns about the possible side effects. Similarly, there was a higher likelihood that a participating patient was diagnosed by their current dermatologist. Further differences among the participating and non-participating patient groups are described in Supplementary Table 1.

Table 1 Association of WPAI activity impairment and WPL with covariates (only significant results included)

	WPAI: activity impairment (n = 242)		WPAI: WPL (n = 170)	
	n (%)	Mean (SD) or Pearson correlation[a,b]	n (%)	Mean (SD) or Pearson correlation[a,b]
Patient demographics and characteristics				
Patient sex		*		
Male	118 (48.8%)	10.8 (16.5)	90 (52.9%)	9.9 (16.5)
Female	124 (51.2%)	15.6 (19.7)	80 (47.1%)	14.8 (18.1)
Patient smoking status		*		*
Current smoker	22 (11.2%)	20.9 (19.7)	17 (11.7%)	19.7 (23.2)
Ex-smoker	41 (20.9%)	8.0 (13.6)	33 (22.8%)	7.5 (11.2)
Never smoked	133 (67.9%)	13.2 (18.9)	95 (65.5%)	12.1 (16.4)
AA clinical characteristics, disease history				
When did this patient first experience symptoms of alopecia areata?		**		**
Infancy (0–2 years)	5 (2.2%)	2.0 (4.5)	2 (1.2%)	0.0 (0.0)
Childhood (3–11 years)	11 (4.8%)	23.6 (22.5)	7 (4.3%)	20.2 (26.6)
Adolescent (12–17 years)	19 (8.2%)	25.3 (24.1)	10 (6.1%)	26.7 (22.7)
Adult (18 years or older)	196 (84.8%)	12.2 (17.1)	145 (88.4%)	10.6 (14.9)
How long did it take before you decided to talk to a doctor about your hair loss concerns? (years)		***		
	228 (100.0%)	0.254	161 (100.0%)	0.098
Before your first visit to the doctor did you use treatment bought from a pharmacy without a prescription?		***		*
Yes	47 (20.6%)	23.0 (20.1)	31 (19.5%)	19.5 (17.9)
No	181 (79.4%)	11.7 (17.5)	128 (80.5%)	11.3 (17.4)
Years since diagnosis of alopecia areata		**		***
	224 (100.0%)	0.192	155 (100.0%)	0.317

Table 1 continued

	WPAI: activity impairment(n = 242)		WPAI: WPL(n = 170)	
	n (%)	Mean (SD) or Pearson correlation[a,b]	n (%)	Mean (SD) or Pearson correlation[a,b]
Who did you first see about your hair loss?		*		*
Current doctor	126 (53.8%)	11.0 (16.6)	90 (54.5%)	9.4 (14.9)
Other provider	108 (46.2%)	15.9 (19.9)	75 (45.5%)	15.7 (19.6)
What areas of your body have been affected by hair loss?				
Eyebrows		*		
Never affected	195 (80.6%)	11.6 (16.6)	135 (79.4%)	11.6 (17.2)
Previously affected	2 (0.8%)	15.0 (7.1)	2 (1.2%)	19.6 (0.5)
Currently affected, or currently and previously affected	45 (18.6%)	20.4 (23.8)	33 (19.4%)	14.4 (18.8)
Eyelashes		***		**
Never affected	208 (86.0%)	11.0 (15.9)	147 (86.5%)	10.7 (16.0)
Previously affected	4 (1.7%)	32.5 (22.2)	3 (1.8%)	29.7 (17.5)
Currently affected, or currently and previously affected	30 (12.4%)	26.3 (26.1)	20 (11.8%)	21.0 (23.1)
Nasal hair		***		*
Never affected	234 (96.7%)	12.4 (17.4)	164 (96.5%)	11.7 (17.2)
Previously affected	4 (1.7%)	40.0 (29.4)	4 (2.4%)	35.0 (12.9)
Currently affected, or currently and previously affected	4 (1.7%)	40.0 (24.5)	2 (1.2%)	10.0 (14.1)
Beard				*
Never affected	211 (87.2%)	13.8 (18.9)	142 (83.5%)	12.1 (16.7)
Previously affected	2 (0.8%)	30.0 (42.4)	2 (1.2%)	42.0 (59.4)
Currently affected, or currently and previously affected	29 (12.0%)	7.9 (10.1)	26 (15.3%)	10.7 (16.0)
Fingernails		**		*

Table 1 continued

	WPAI: activity impairment(n = 242)		WPAI: WPL(n = 170)	
	n (%)	Mean (SD) or Pearson correlation[a,b]	n (%)	Mean (SD) or Pearson correlation[a,b]
Never affected	221 (91.3%)	13.5 (18.5)	154 (90.6%)	12.5 (17.7)
Previously affected	2 (0.8%)	50.0 (14.1)	1 (0.6%)	50.0 (NA)
Currently affected, or currently and previously affected	19 (7.9%)	6.3 (10.1)	15 (8.8%)	6.4 (9.4)
Toenails		*		*
Never affected	237 (97.9%)	12.8 (18.0)	167 (98.2%)	11.8 (16.6)
Previously affected	1 (0.4%)	30.0 (NA)	1 (0.6%)	30.0 (NA)
Currently affected, or currently and previously affected	4 (1.7%)	35.0 (30.0)	2 (1.2%)	42.0 (59.4)
Physician assessment of current AA severity		**		**
Mild	53 (21.9%)	7.4 (14.2)	42 (24.7%)	5.1 (11.9)
Moderate	129 (53.3%)	12.7 (16.1)	89 (52.4%)	12.8 (17.3)
Severe	60 (24.8%)	19.7 (23.6)	39 (22.9%)	18.4 (20.2)
Physician assessment of current AA progression		**		*
Improving	81 (33.5%)	10.5 (16.9)	63 (37.1%)	8.2 (15.6)
Stable	72 (29.8%)	10.4 (15.7)	54 (31.8%)	12.7 (16.2)
Changeable	45 (18.6%)	23.1 (20.8)	25 (14.7%)	21.7 (22.3)
Worsening slowly	19 (7.9%)	12.1 (22.7)	9 (5.3%)	14.3 (17.6)
Worsening rapidly	25 (10.3%)	13.6 (16.8)	19 (11.2%)	10.6 (15.5)
What percentage of this patient's scalp is currently affected by hair loss due to their alopecia areata?		*		*
	227 (100.0%)	0.156	166 (100.0%)	0.173
What type of alopecia areata does this patient have now?		*		*
Monolocularis	42 (17.4%)	8.8 (14.7)	24 (14.1%)	4.6 (8.6)
Multilocularis/Diffuse/Ophiasis	186 (76.9%)	13.4 (17.9)	134 (78.8%)	12.8 (17.3)

Table 1 continued

	WPAI: activity impairment(n = 242)		WPAI: WPL(n = 170)	
	n (%)	Mean (SD) or Pearson correlation[a,b]	n (%)	Mean (SD) or Pearson correlation[a,b]
Totalis/Universalis	14 (5.8%)	25.0 (28.5)	12 (7.1%)	20.7 (25.7)
Economic burden of AA				
Do you have health insurance that includes cover for your hair loss treatment?				*
Yes	220 (92.4%)	13.5 (18.5)	158 (94.6%)	12.9 (17.8)
No	18 (7.6%)	9.4 (17.3)	9 (5.4%)	0.0 (0.0)

AA alopecia areata, *NA* not applicable, *WPAI* Work Productivity and Activity Impairment, *WPL* work productivity loss
[a]Mean (SD) presented for categorical factors and Pearson correlations for continuous factors
[b]p-values reported from ANOVA F-test for categorical factors and Pearson correlations two-sided t-test for continuous factors
p-values: *** = < 0.001, ** = < 0.01, * = < 0.05

DISCUSSION AND CONCLUSIONS

This study demonstrated that worsening ES related to AA had a significant impact on WPL and activity impairment. On average, work productivity and daily activity declined by 25% or more per 1-point (about equal to 1 SD) worsening in ES. To our knowledge, this was the first study to quantify this effect, confirming the relationship between ES and economic burden and also addressing a research gap on the economic burden of AA. The results also indicated that WPL was mostly affected by a decline in performance at work (presenteeism) and not absenteeism, which was in line with findings from Mesinkovska et al. [14], Senna et al. [24], and studies on productivity in patients with psoriasis [25, 26] and atopic dermatitis [27]. A recent study by Senna et al. [24] conducted a cross-sectional survey of 259 patients with AA to assess the association between the impact of AA severity and patient characteristics, the Skindex-16 AA, and the WPAI. The results showed that highest impairment was observed for the Skindex-16 AA emotions and the WPAI daily activity performance scores—functioning domains rather than physical symptoms domain [24]. These patterns are consistent with the similar combination of high psychological impact but low physical impairment and hospitalization burden of AA and other autoimmune skin diseases.

The mean WPL of 12.2% and activity impairment of 13.3% found in this study were attenuated in contrast to those reported for patients with psoriasis. In a multinational study [25], the mean (95% CI) WPL in patients with mild, moderate, and severe psoriasis was 10.1% (8.4–11.8), 18.9% (16.9–20.8), and 29.4% (26.5–32.4), respectively. For US patients with psoriasis, Villacorta et al. reported a mean WPL of 18% [25]. A US and Canadian open-label phase 3b psoriasis trial reported baseline WPAI mean (SD) estimates of 0.8% (4.3%) absenteeism, 12.0% (19.0%) presenteeism, 12.8% (19.7%) WPL, and 22.4% (14.9%) activity impairment [26].

The results of this study should, however, be considered in the context of several limitations. First, the cross-sectional data limit our ability to make any temporal causality arguments for the ES effect on the WPAI outcomes. However, as

Table 2 Linear multiple regression results

	Estimate (95% CI)	*p*-value[a]
1. WPAI: WPL—Overall fit *R*-squared: 0.288; $n = 142$[b]		
AAPPO ES (0 to 4)—Slope	4.115% (1.584%, 6.647%)	0.002
Change in outcome per 1-SD decrease in ES scale[c]	−4.485% (−7.245%, −1.727%)	
Improvement in WPL for average patient (mean 12.2) per 1-SD decrease in ES scale	(4.485/12.2) × 100% = 37%	
2. WPAI: Activity impairment—Overall fit *R*-squared: 0.319; $n = 218$[d]		
AAPPO ES (0 to 4)—Slope	3.061% (0.732%, 5.390%)	0.010
Change in outcome per 1-SD decrease in ES scale[c]	−3.336% (−5.875%, −0.798%)	
Improvement in activity impairment for average patient (mean 13.3) per 1-SD decrease in ES scale	(3.3/13.3) × 100% = 25%	

AAPPO ES Alopecia Areata Patient Priority Outcomes emotional symptoms, *SD* standard deviation, *WPAI* Work Productivity and Activity Impairment, *WPL* work productivity loss

[a]Two-sided *t*-test

[b]Selected covariates included years since diagnosis, use of over-the-counter medication prior to first doctor visit, AA progression, and insurance coverage for hair loss treatment. Of the $n = 170$ employed patients with valid absenteeism and presenteeism responses, 28 patients had missing values for years since diagnosis or use of over-the-counter medication prior to first doctor visit

[c]AAPPO ES SD = 1.09

[d]Selected covariates included years since first AA symptoms, use of over-the-counter medication prior to first doctor visit, AA severity, AA progression, and indicators for body parts affected (nasal hair, beard, fingernails). Of the $n = 170$ employed patients with valid absenteeism and presenteeism responses, 28 patients had missing values for years since diagnosis or use of over-the-counter medication prior to first doctor visit

far as the directionality of the association found between HL-related ES and the WPAI outcomes, it is more likely that the HL-related ES, including self-consciousness, embarrassment, and frustration, may affect WPL or activity impairment and not the other way around.

Another aspect of the causal path being debated is the bidirectional relationship between HL and stress, specifically in AA patients [28]. The HL-related ES association with productivity outcomes evaluated in this study may, at least in part, be related to unmeasured premorbid stress or personality attributes. Unmeasured conditions such as premorbid stress could not be controlled for in this analysis; therefore, associations should be interpreted with caution. However, items in the AAPPO instrument may limit potential confounding by emphasizing the HL-specific impact and emotions; for instance, "Over the past week, how often did you feel sad about your hair loss?"

Lastly, due to observed differences between survey participating and non-participating patient groups, there is a potential for bias. Patients who participated in the survey were less impaired due to AA from the perspective of their dermatologist, which indicates the potential bias in our results since more severely emotionally affected patients may be underrepresented in our AA patient sample, restricting the range of the AAPPO ES scale. The bias may have resulted in a diminished AAPPO ES estimated effect size and a lower observed sample mean for WPL and activity impairment.

Participating patients were also more likely to have higher BMI and have a history of smoking and comorbidity (other than mental or autoimmune-related conditions), compared with non-participating patients. These differences may have had an inverse impact of increasing the observed sample mean for WPL and activity impairment, but there was no direct impact on AAPPO ES estimated effect size as these variables were not significantly associated with the outcomes and hence not included in models. In addition, our sample may not be representative of the AA patient population in the USA, and results may not be generalizable to other AA patient populations.

We quantified the impact of AA-related ES on work productivity and activity impairment among patients with AA, and the results suggest a negative impact of worsening AA-related ES on the outcomes. These findings highlight the need for clinical management of AA and associated ES, given potential consequences to patients' work productivity and daily activity. However, further research is warranted to determine whether treatments aiming to improve clinical outcomes (hair loss) can reverse these productivity losses.

ACKNOWLEDGEMENTS

Funding. Pfizer, Inc. funded the study and participated in the study design, research, analysis, data collection, interpretation of data, reviewing, and approval of the publication. The Rapid Service Fee was funded by Pfizer.

Medical Writing, Editorial, and Other Assistance. We thank Lauren Bartolome (Pfizer employee) for her valuable comments and assistance with reviewing of the manuscript. We also acknowledge the support provided by Engage Scientific Solutions, funded by Pfizer, which consisted solely of copyediting and manuscript formatting; no contribution was made to content.

Authorship. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Author Contribution. All authors contributed to the study conception, design, data acquisition, analysis, interpretation, and drafting and revising the manuscript.

Disclosures. Kavita Gandhi and Markqayne Ray were employees of Pfizer at time of study conduct and completion. Kavita Gandhi is currently an employee of Janssen Pharmaceutical Companies of Johnson and Johnson (JNJ) and holds stock/stock options of JNJ. Markqayne Ray is currently an employee of Kite, A Gilead Company, Santa Monica, CA. Moshe Fridman and Morgan Shy are employees of AMF Consulting, which received payment from Pfizer Inc. for participation in this research. Moshe Fridman also served as consultant to Arena Pharmaceuticals, CSL Behring, Gilead Sciences, Janssen Global Services, Jazz Pharmaceuticals, Kala Pharmaceuticals, KalVista Pharmaceuticals, and Novo Nordisk. Shailja Vaghela is an employee of HealthEcon Consulting, Inc. and an external consultant for Pfizer who has received consulting fees from Pfizer for this study. Arash Mostaghimi reports consulting fees from Pfizer, Concert, Lilly, AbbVie, hims, and 3Derm, and equity from Lucid and hims.

Compliance with Ethics Guidelines. Institutional review board (IRB) exemption for the study was granted by the Western IRB. The survey was performed in accordance with relevant legislation at the time of data collection, including the US Health Insurance Portability and Accountability Act 1996 [HIPAA 2003], and Health Information Technology for Economic and Clinical Health Act legislation [HITECCH Act]. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

Data Availability. All data supporting the survey are the intellectual property of Adelphi

Real World and can be made available upon a reasonable request to the corresponding author.

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