

# Lifestyle Behaviors in Patients with Atopic Dermatitis: Results of a Cross-Sectional Study following a Randomized Controlled Trial

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## Keywords

Atopic dermatitis · Lifestyle · Exercise · Relaxation · Diet

## Abstract

**Background:** The severity of atopic dermatitis (AD) is associated with lifestyle behaviors such as exercise, relaxation techniques, and dietary or nutritional adjustments. **Objective:** The aim of this study was to investigate the frequency of self-initiated exercise, relaxation techniques, and dietary or nutritional adjustments and their perceived benefits in patients with AD. **Methods:** An exploratory cross-sectional study was performed in May 2019 with 115 AD patients who participated in a threearmed randomized controlled trial (the CAMATOP study). Data on lifestyle behaviors in the three domains of exercise, relaxation techniques, and dietary or nutritional adjustments and their perceived benefits were collected anonymously by a questionnaire and exploratively evaluated. **Results:** A total of 58 (50.4%) patients responded and were included in the analyses. Within the previous 4 months, 54 (93.1%) respondents had performed exercise, and 24 (41.4%) respondents had used a relaxation technique. A total of 44 (75.9%) respondents had adjusted their diet or nutrition intake due to AD. Exercise, relaxation techniques, and dietary or nutritional adjustments were rated as helpful by most respondents (57.4%, 87.0%, and 95.1%,

respectively). Overall, 54 (93.1%) respondents adopted at least one lifestyle factor, and 13 (22.4%) adopted a lifestyle factor in all three domains. **Conclusion:** In our sample, AD patients often adopted lifestyle behaviors such as exercise, relaxation techniques, diet and nutrition and perceived relaxation techniques and nutritional adjustments as helpful. Further high-quality cohort studies and prospective clinical trials should evaluate the benefits and possible risks of potentially healthy lifestyle behaviors in AD patients.

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## Lebensstilverhalten bei Patienten mit atopischer Dermatitis: Ergebnisse einer Querschnittsstudie im Anschluss an eine randomisierte, kontrollierte Studie

### Schlüsselwörter

Atopische Dermatitis · Lebensstil · Bewegung · Entspannung · Ernährung

### Zusammenfassung

**Hintergrund:** Der Schweregrad der atopischen Dermatitis (AD) steht in Zusammenhang mit Lebensstilverhalten wie Bewegung, Entspannungstechniken und Diät oder Ernährungsanpassung. **Zielsetzung:** Es wurde untersucht, wie häufig Patienten und Patientinnen mit AD sich sportlich bewegen, Entspannungstechniken anwenden

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oder ihre Ernährung anpassen und welchen Nutzen sie darin für sich sehen. **Methoden:** Im Mai 2019 wurde eine explorative Querschnittsstudie an 115 Patienten und Patientinnen mit AD, welche zuvor an einer dreiarmligen randomisierten kontrollierten Studie (der CAMATOP-Studie) teilgenommen hatten, durchgeführt. Daten zum Lebensstilverhalten in den drei Bereichen Bewegung, Entspannungstechniken und Diät oder Ernährungsanpassungen sowie deren wahrgenommener Nutzen wurden anonym mittels eines Fragebogens erhoben und explorativ ausgewertet. **Ergebnisse:** Insgesamt 58 (50,4%) Patienten und Patientinnen antworteten und wurden in die Analysen einbezogen. Innerhalb der letzten vier Monate hatten 54 (93,1%) der Befragten sich sportlich bewegt und 24 (41,4%) hatten eine Entspannungstechnik angewandt. Insgesamt 44 (75,9%) der Befragten hatten eine Diät durchgeführt oder ihre Ernährung aufgrund von AD angepasst. Bewegung, Entspannungstechniken und Diät oder Ernährungsanpassung wurden von den meisten Befragten als hilfreich eingestuft (57,4%, 87,0% bzw. 95,1%). Insgesamt wandten 54 (93,1%) der Befragten mindestens einen Lebensstilfaktor an und 13 (22,4%) wandten einen Lebensstilfaktor in allen drei Bereichen an. **Schlussfolgerung:** In unserer Stichprobe nutzten Patienten und Patientinnen mit AD häufig Lebensstilverhalten wie Bewegung, Entspannungstechniken und Diät oder Ernährungsanpassung und empfanden Entspannungstechniken und Diät oder Ernährungsanpassungen als hilfreich. Weitere qualitativ hochwertige Kohortenstudien und prospektive klinische Studien sollten den Nutzen und die möglichen Risiken potenziell gesunden Lebensstilhaltens bei Patienten und Patientinnen mit AD untersuchen.

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## Introduction

Atopic dermatitis (AD, synonyms: atopic eczema, neurodermatitis) has a high lifetime prevalence of up to 23% in Germany [1, 2]. AD is associated with high personal, social, and economic burdens [3]. Symptomatic treatment, even with topical corticosteroids (TCSs), is associated with a risk of relevant adverse events. Cutaneous adverse events include atrophy, striae, rosacea, hypertrichosis, pigmentation alterations, delayed wound healing, exacerbation of skin infections; systemic reactions can include hyperglycemia, glaucoma, and adrenal insufficiency [4, 5]. Thus, patients tend to avoid and worry about treatment [6, 7].

Despite therapeutic improvements, not all AD symptoms can be sufficiently alleviated by treatment, and patients undertake lifestyle interventions. German AD guidelines recommend the optimization of lifestyle behaviors such as exercise [8], relaxation techniques [8],

and dietary and nutritional adjustments [8, 9]. The severity of AD is associated with lifestyle factors, and stress and diverse nutritional factors can aggravate symptoms [10–12]. It is necessary to encourage AD patients to exercise and maintain a healthy lifestyle [13]. The benefits of a healthy lifestyle in AD patients have been investigated in the fields of conventional medicine and complementary medicine (CM). To date, positive effects of exercise [14–16], relaxation hypnotherapy [17–21], and dietary or nutritional adjustments, such as time-restricted eating and the application of a low-calorie vegetarian/vegan diet [22–25], have been reported in case reports and mostly explorative studies. However, few data are available about self-application of lifestyle behaviors in Germany. The aim was to investigate the self-application of lifestyle behaviors in the domains of exercise, relaxation techniques, and dietary or nutritional adjustments and their subjectively perceived benefits in patients with AD.

## Methods

### Study Design and Setting

An exploratory cross-sectional study was performed and included the participants of the Complementary Medicine in Atopic Dermatitis (CAMATOP) study [26]. The CAMATOP study was conducted by the Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin in Berlin (participants' inclusion between October 2017 and October 2018).

The CAMATOP study was a three-armed randomized controlled explorative clinical trial. In the CAMATOP study, the effectiveness of acupuncture (eight semistandardized treatments of 30 min at 1- to 2-week intervals) and osteopathic medicine (five 45-min semistandardized treatments at approximately 2-week intervals) was investigated in adult AD patients with an average perceived skin itching intensity between 40 and 80 mm on a visual analog scale (VAS, 0–100 mm, 0 = no itching, 100 = maximum imaginable itching) [27] over the last 7 days. The main exclusion criteria were other types of dermatosis, the use of systemic corticosteroids, the use of class IV TCSs (class I–III TCSs were permitted), and the use of systemic AD medications (e.g., immunomodulators). The CAMATOP study enrolled participants between October 2017 and October 2018 (last follow-up after 26 weeks). A total of 121 AD patients (90 females; 78.3%) with a mean age of  $31.5 \pm 10.5$  years and an AD duration of  $27.0 \pm 12.4$  years were enrolled. At the last follow-up at 26 weeks, 6 patients had dropped out of the study. In the CAMATOP study, patients reported the frequent use of and great interest in more active and self-applicable treatments, such as exercise, relaxation techniques, and dietary or nutritional adjustments. All patients gave oral and written informed consent before their inclusion in the CAMATOP study. We conducted this exploratory cross-sectional study as a supplementary survey among participants of the CAMATOP study after its completion.

### Patients

To recruit participants, 115 adult patients with AD from the CAMATOP study were contacted one time post hoc and received a questionnaire with a prepaid return envelope. Further inclusion or exclusion criteria in addition to those of the CAMATOP study were not specified.

**Table 1.** Exercise: results of the patients who had performed any exercise within the previous 4 months

	Exercised in previous 4 months		NRS-perceived exertion during exercise <sup>a</sup>	Helpful
	N = 58 N (%)	minutes/week mean ± SD [range]	mean ± SD [range]	N (%) <sup>b</sup>
Endurance sports (e.g., swimming, jogging, cycling, exercise bike)	40 (69.0)	110.0±101.2 [10–400]	4.9±2.2 [0–9]	19 (47.5)
Weight training (e.g., with weights/body weight exercises)	19 (32.8)	64.0±54.1 [15–240]	6.6±2.1 [2–9]	9 (47.4)
Game sports/ball sports (e.g., soccer, volleyball, tennis, handball)	8 (13.8)	69.4±63.2 [10–180]	7.0±1.8 [3–9]	6 (66.7)
Martial arts/dueling sports (e.g., judo, kung fu)	3 (5.2)	90.0±42.4 [60–120]	8.5±0.7 [8–9]	0
Gymnastics/aerobics/fitness (includes yoga, pilates)	33 (56.9)	74.1±45.9 [5–180]	4.6±1.9 [0–8]	16 (50.0)
Dance sports	10 (17.2)	72.2±50.7 [10–180]	4.6±2.0 [2–9]	4 (40.0)
Technical sports (e.g., ski, snowboard)	5 (8.6)	152.5±37.7 [100–180]	7.5±1.0 [6–8]	2 (40.0)
Other physical activity (e.g., housework or gardening, occupation)	36 (62.1)	332.6±411.7 [5–2,000]	3.7±2.5 [0–10]	14 (38.9)
Total (performing exercise from any category)	54 (93.1)	382.2±392.6 [5–2,150]	13.8±8.5	31 (57.4)

N, number; NRS, numeric rating scale; SD, standard deviation. <sup>a</sup> range (0–10, 0 = no exhaustion, 10 = maximum exhaustion). <sup>b</sup> % are valid percent.

**Table 2.** Relaxation techniques: results of the patients who had applied any relaxation techniques within the previous 4 months

	Relaxation techniques applied in the previous 4 months	Helpful
	N = 24 N (%)	N (%) <sup>a</sup>
Hypnosis	1 (1.7)	1 (100.0)
Meditation	14 (24.1)	11 (84.6)
Visualization	4 (6.9)	1 (33.3)
Progressive muscle relaxation	5 (8.6)	3 (75.0)
Autogenous training	5 (8.6)	4 (80.0)
Mindfulness training	1 (1.7)	1 (100.0)
Yoga	3 (5.2)	3 (100.0)
Breathing exercises	2 (3.4)	2 (100.0)
Other	1 (1.7)	0
Any relaxation technique	24 (41.4)	20 (87.0)

N, number. <sup>a</sup>% are valid percent.

### Outcome Measurements and Data Collection

During the CAMATOP study, patients had multiple interpersonal contacts with the study center, and to ensure independent valid data, the study was designed to be anonymous. Therefore, no sociodemographic data were collected. Data on the frequency of self-exercise, relaxation techniques, and dietary or nutritional adjustments and whether they were perceived as helpful were collected by a self-administered questionnaire (presented in the online suppl. material; see [www.karger.com/doi/10.1159/000527107](http://www.karger.com/doi/10.1159/000527107) for all online suppl. material). The retrospective survey period of 4 months for exercise and relaxation techniques was chosen to ensure a sufficient survey period and reduce recall bias. All data were collected anonymously and entered via the SoSci Survey [28] in July 2019.

### Exercise

To obtain indications for self-initiated exercise in AD patients, the respondents first indicated whether they had performed any exercise during the previous 4 months (yes/no). To further classify the type of exercise, we modified the classification of Schönfelder [29]. The categories “technical-compositional” and “technical-apparative” sports were combined into one category: “techni-

cal sports.” The resulting categories are displayed in Table 1. To determine their perceived exertion during exercise, we modified the 11-item Perceived Exertion Scale [30–32]. The patients rated their perceived exhaustion on a numeric rating scale for each category (NRS, 0–10, 0 = no exhaustion, 10 = maximum exhaustion). To assess whether the respondents followed the official recommendations for exercise per week [33–35], we used the World Health Organization (WHO) classification [34] (moderate intensity at 5/10 and 6/10, vigorous intensity at 7/10 and 8/10, or more in addition to the WHO classification) and grouped participants into groups of “no,” “no, but 150 min (min) or more of light intensity,” “yes, 150 min or more of moderate intensity,” and “yes, 75 min or more of vigorous intensity.” Furthermore, the patients indicated whether they found the exercises in each category to be helpful.

### Relaxation Techniques

The patients indicated whether they had applied a relaxation technique during the previous 4 months and specified the technique if applicable. The techniques are displayed in Table 2. Furthermore, the patients indicated whether they found each relaxation technique to be helpful.

**Table 3.** Diet or nutritional adjustments: results of the patients who had adjusted their diet or nutrition

	Dietary or nutritional adjustment <i>N</i> (%)	Helpful <i>N</i> (%) <sup>a</sup>
Any dietary or nutritional modification	44 (75.9)	39 (95.1)
Nutritional regimen ( <i>n</i> = 30, 51.7%)		
Whole foods	11 (19.0)	10 (100.0)
Vegetarian (including dairy products, egg)	11 (19.0)	7 (63.6)
Vegetarian (excluding dairy products, egg)	5 (8.6)	5 (100.0)
Vegan (no animal products)	0	0
Ayurvedic	0	0
Paleo	1 (1.7)	1 (100.0)
Gluten free	2 (3.4)	2 (100.0)
Wheat free	1 (1.7)	1 (100.0)
Chinese diet	1 (1.7)	1 (100.0)
Whole exclusive dairy products	1 (1.7)	0
Other	1 (1.7)	1 (100.0)
Dietary restriction ( <i>n</i> = 39, 67.2%)		
Dairy products	20 (34.5)	17 (89.5)
Wheat	18 (31.0)	16 (94.1)
Gluten	8 (13.8)	7 (87.5)
Foods rich in histamines	16 (27.6)	15 (100.0)
Refined sugar	21 (36.2)	18 (100.0)
Solanaceous plants (e.g., tomatoes)	11 (19.0)	10 (90.9)
Processed food	21 (36.2)	15 (93.8)
Nuts total/individual types	13 (22.4)	12 (92.3)
Fruit types	16 (27.6)	15 (93.8)
Crustaceans	7 (12.1)	3 (50.0)
Caffeinated drinks	8 (13.8)	5 (83.3)
Alcoholic drinks	17 (29.3)	13 (100.0)
Other	1 (1.7)	1 (100.0)
Increased intake of certain foods ( <i>n</i> = 22, 37.9%)		
Vegetables	13 (22.4)	10 (100.0)
Fish oil/omega-3 fatty acids supplements	4 (6.9)	2 (66.7)
Fruits	5 (8.6)	3 (75.0)
Vitamin D	5 (8.6)	3 (75.0)
Probiotics (e.g., yogurt, fermented vegetables)	7 (12.1)	5 (83.3)
Organic food	14 (24.1)	10 (100.0)
Linseed oil	6 (10.3)	2 (66.7)
Ginger	4 (6.9)	3 (75.0)
Other	6 (10.3)	4 (100.0)

*N*, number. <sup>a</sup>% are valid percent.

#### Dietary or Nutritional Adjustments

The patients who followed a particular *nutritional regimen* indicated whether they consciously increased or restricted the intake of certain foods and specified such factors if applicable. The specifications of the dietary and nutritional adjustments are displayed in Table 3. Furthermore, the patients indicated whether they found each of the dietary or nutritional adjustments to be helpful.

#### Statistical Analysis

As this was an exploratory cross-sectional study among the participants of the CAMATOP study, a sample size calculation was not performed. The evaluation of the data was quantitative, descriptive, and explorative. The data were evaluated descriptively using mean values, standard deviations, and absolute and relative frequencies. For missing data, no imputation was performed. Since it was expected that not all patients would respond, we calculated the frequencies for the domains of exercise, relaxation techniques, and dietary or nutritional adjustments in all the approached pa-

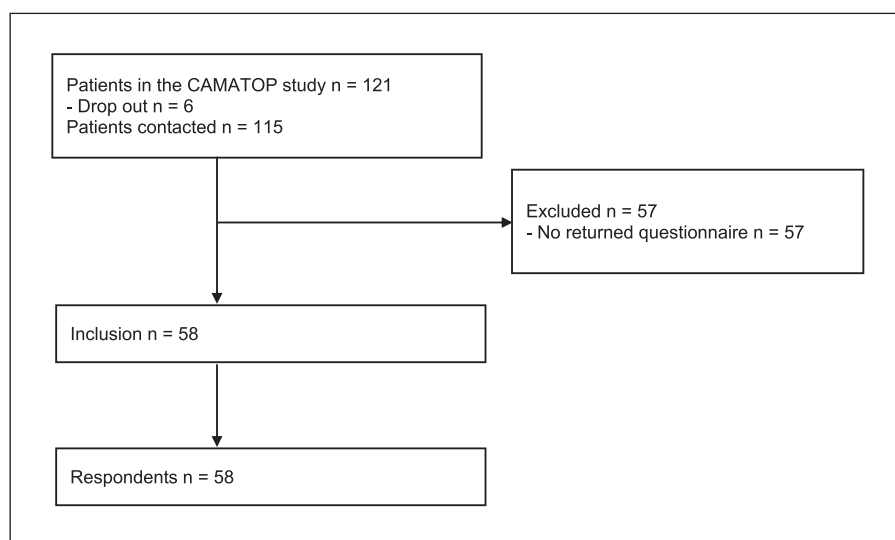
tients as well. Statistical analyses were performed with IBM SPSS for Windows Version 26 or higher [36] using the file provided by SoSci Survey.

## Results

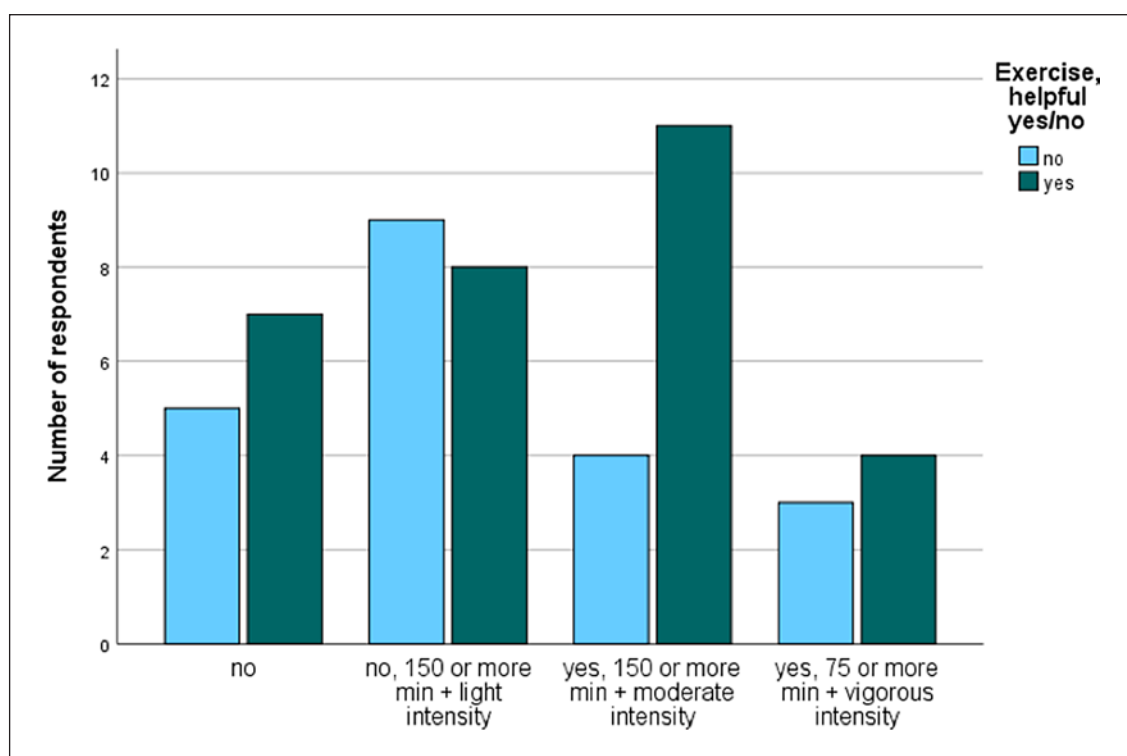
On May 6, 2019, 115 patients with AD were contacted, and 58 (50.4% response rate) patients returned the questionnaire, as shown in Figure 1.

#### Exercise

During the 4 months prior to the questionnaire, 54 (93.1%) respondents had exercised (Table 1), and the average mean  $\pm$  standard deviation was 382.2  $\pm$  392.6 min



**Fig. 1.** Recruitment and respondents.



**Fig. 2.** Exercise according to the World Health Organization (WHO) recommendations.

per week (range 5–2,150 min). The most frequent exercise category was endurance sports, with 40 (69.0%) respondents included in this category. Most of the respondents (45, 77.6%) performed exercises in more than one exercise category (range 2–6 different exercise categories). Altogether, 22 (37.9%) respondents fulfilled the WHO recommendations for exercise per week: 15 (25.9%) performed 150 or more min/week of moderate-intensity exercise and 7 (12.1%) performed 75 or more min/week of vigorous-intensity exercise. Among the 54 respon-

dents who answered the questionnaire and reported performing exercise, it was rated as helpful by most respondents (31, 57.4%), especially those performing 150 or more min/week of moderate-intensity exercise, as shown in Figure 2.

#### *Relaxation Techniques*

During the 4 months prior to the questionnaire, at least one relaxation technique was applied by 24 (41.4%) respondents (Table 2). The most frequently used tech-



nique was meditation, which was used by 14 (24.1%) respondents, 11 (84.6%) of whom reported meditation as being helpful. Only one relaxation technique was applied by 15 (25.9%) respondents, two relaxation techniques by six respondents, and three relaxation techniques by three respondents. Most respondents who answered the questionnaire and applied at least one relaxation technique found it to be helpful ( $n = 20$ , 87.0%).

#### *Dietary or Nutritional Adjustments*

In total, 44 respondents (75.9%) adjusted their nutritional intake, and more than one-third ( $n = 18$ , 31.0%) made adjustments in all three diet or nutrition sections.

#### *Nutritional Regimen*

Approximately half of the respondents followed a nutritional regimen ( $n = 30$ , 51.7%, Table 3), with the two most frequently and equally applied adjustments being “whole food” and “vegetarian including dairy products and eggs” regimens (both with  $n = 11$ , 19.0%).

#### *Dietary Restrictions*

Two-thirds of the respondents reported dietary restrictions due to AD ( $n = 39$ , 67.2%); the most often restricted foods were refined sugar and processed foods (both with  $n = 21$ , 36.2%), but dairy products were also often restricted ( $n = 20$ , 34.5%).

#### *Increasing the Intake of Certain Foods*

More than one-third of the respondents reported an increased intake of certain foods because of AD ( $n = 22$ , 37.9%); these foods were most often organic foods ( $n = 14$ , 24.1%) and vegetables ( $n = 13$ , 22.4%). Out of the 44 respondents who answered the questionnaire and applied any dietary or nutritional adjustments, 39 (95.1%) found them to be helpful.

#### *Overall Frequencies of Lifestyle Behaviors and Perceived Helpfulness*

Overall, 54 (93.1%) respondents reported applying at least one lifestyle factor. Out of all the respondents, 13 (22.4%) adopted lifestyle behaviors in all three domains: exercise, relaxation techniques, and dietary or nutritional adjustments.

#### *Minimum Frequency of Lifestyle Behaviors Used with Regard to the Approached Population*

The calculated minimum frequency of lifestyle behaviors used by all approached patients for each domain was as follows: at least 47.0% performed exercise, at least 20.9% applied a relaxation technique, and at least 38.3% made dietary or nutritional adjustments.

## **Discussion**

This exploratory cross-sectional study provides an overview of adopted lifestyle behaviors in 58 AD patients (response rate 50.4%). Within the 4 months prior to the questionnaire, 93.1% of the respondents had performed exercise, and 41.4% had applied at least one relaxation technique. Overall, 75.9% of the respondents applied dietary or nutritional adjustments due to AD. The respondents who adopted certain lifestyle behaviors found them to mostly be helpful; 57.4% of those who performed exercise, 87.0% of those who used a relaxation technique, and 95.1% of those who applied dietary or nutritional adjustments found the adjustments to be helpful.

This study is, to our knowledge, one of the few studies to assess the frequencies of adopted lifestyle behaviors and their perceived benefits in AD patients in Germany by means of a questionnaire in a defined population. The short study time, the inclusion of only former participants of a study on CM in AD patients, and the monocenter design provided a quite homogenous study population. Another strength is that all respondents carefully completed all three domains of the questionnaire.

The main limitation was the overall response rate, as approximately only half of the contacted patients responded. This could have led to an overestimation of the reported results. The approached patients who had adopted lifestyle behaviors might have been more inclined to return the questionnaire. However, we calculated the minimum frequency of lifestyle behaviors adopted in the approached population for each domain, which indicated high adoption of the lifestyle behaviors of interest. The response rate of approximately half of the contacted patients in our study might be due to the single approach of sending a letter on one date. The response rate might have been higher if we had used a digital survey and/or reminders. Although the inclusion of only former participants of a study on CM in AD patients and the monocentric study design resulted in a homogenous study population, no general conclusions for AD patients in Germany are possible. We did not use validated questionnaires, which reduces the comparability with other studies. Another limitation is that we did not analyze the sociodemographic data of the population in our study, which limits the estimation for external validity. We decided to design our study to retain anonymity among the patients of the CAMATOP study to obtain more independent valid data and not “good-looking” answers. Another limitation is the cross-sectional design because the 4-month retrospective evaluation in the domains of exercise and relaxation techniques entails a risk of recall bias, which could have led to under- or overestimation of the frequencies compared to the domain of dietary or nutritional adjustments. To ensure a sufficient survey period and reduce

recall bias, a retrospective survey period of (only) 4 months was chosen. This might have led to an underestimation of exercise activities, since the survey period essentially covered the time between January and April, and outdoor physical activities are usually lower in the winter months. Another limitation is the assessment of self-perceived benefits (“helpful”), as no contextual information was provided and the participants might have provided answers to the question that were not entirely directly related to AD. In this cross-sectional study, only the frequencies of the adoption of lifestyle behaviors and their perceived benefits could be estimated. To measure the benefits/harms of lifestyle behaviors and the changes in disease severity, cohort studies are needed.

### Exercise

Lack of exercise is a well-known risk factor that threatens health and life, and to improve health, exercise is recommended for the general population [37]. Adults aged 18–64 years should perform at least 150 min or more of moderate-intensity aerobic physical activity or 75 min or more of vigorous-intensity aerobic physical activity per week, as recommended by the WHO [33–35]. However, in the general population in Germany, four out of five adults do not perform at least 150 min per week of moderate-intensity physical activity [38]. In contrast, 93.1% of the respondents in our study had performed exercise during the previous 4 months, and 37.9% fulfilled the official WHO recommendations. Possible explanations for the positive application of exercise in our population could be the young age of the patients in the CAMATOP study (mean age  $31.5 \pm 10.5$  years) and the response rate of approximately half of the approached population, but it could also be specific to AD patients. Scientific evidence of the effects of exercise in AD patients is scarce, and observational studies have focused mostly on the prevalence of AD and obtained inconclusive results. Drucker et al. [39] performed a cross-sectional analysis of the Nurses’ Health Study II (NHS II) on lifestyle behaviors and the lifetime prevalence of AD in 80,096 female nurses. The authors found no association between exercise and the lifetime prevalence of AD. A survey of 3,252 adults in the USA reported that the prevalence of AD in adults was associated with significantly lower levels of moderate-vigorous physical activity ( $-2.12$  min per day [ $-3.92; -0.33$ ]) in multivariate models, but there was no association with light physical activity [16].

In our study, 93.1% of the respondents performed exercise, but just over half rated it to be helpful. This rather low rate in comparison to the other lifestyle behaviors investigated herein might be due to various reasons. First, the study participants might have exercised for reasons other than AD. Furthermore, for the improvement of health, although the duration and intensity of exercise are

very important [40], there is still a need to define the best type and duration of exercise [37]. Regarding the (dose related) effects of exercise on AD symptoms, animal models suggest that high-intensity exercise exacerbates dermatitis in AD model mice and NC/Nga mice, while proper exercise (exercise gave mild stress without no appreciable effect on their behavior) reduces it [41]. In humans, a meta-analysis and an analysis of systematic reviews [42, 43] included seven cross-sectional studies with a total of 61,974 adults and children and found no association between AD and exercise performed once a week or more or three times a week or more (odds ratio 1.04, 95% CI [0.92; 1.17]; odds ratio 1.11, 95% CI [0.88; 1.4], respectively). In addition, no clear conclusion could be drawn due to heterogeneity and a lack of control for confounding factors [43]. To the best of our knowledge, no randomized controlled trial investigating the effects of exercise in patients with AD has been published. Controlled nonrandomized clinical trials in AD inpatients at the German Erlangen University Department of Dermatology [14, 15, 44] reported an improvement in recovery after additional exercise.

Within the exercise category “gymnastics/aerobics/fitness (i.e., yoga, pilates),” 33 participants in our study indicated that they performed activities in this category. A question regarding yoga alone as a possible relaxation technique was also asked, but only 3 participants indicated that they performed it. From our point of view, this difference might be mainly explained by the fact that various exercises fall into the category of gymnastics/aerobics/fitness. Additionally, yoga might not be considered a relaxation technique by all its users.

### Relaxation Techniques

Simpson et al. [45] performed a cross-sectional study with 70 AD patients (age range 4 months to 61 years) at a US university clinic using a self-administered questionnaire; among them, 4.3% reported having undergone hypnosis during their lifetime. In our population, some respondents had undergone hypnosis within the 4 months prior to the questionnaire. In our population, 41.4% of the respondents had used a relaxation technique during the previous 4 months; among them, 4.2% used hypnosis, 58.3% used meditation, 16.7% used visualization, and 12.5% practiced yoga for relaxation. These percentages seem very high, especially for meditation, in comparison to other cross-sectional studies with a broader time frame and in other populations. In our earlier cross-sectional study on competitive athletes (mean age of  $20.2 \pm 6.6$  years, 26% female) [46], 475 participants responded to the inquiry about lifestyle behaviors adopted within the previous 12 months. Among them, 14.9% had used relaxation techniques, 5.3% had practiced meditation, 8.4% had performed visualization, and 7.2% had practiced

yoga. In a recent cross-sectional study, we included 349 medical students (mean age  $23.7 \pm 4.3$  years, 69.0% female) [47]. Within the previous 12 months, out of the whole population, 1.4% had undergone hypnosis, 9.5% had practiced meditation, and 13.5% had practiced yoga.

Vieira et al. [48] conducted a literature review and found limited evidence that hypnosis and perhaps other stress-relieving techniques play at least an adjunctive role in the management of AD. It was reported that hypnosis may improve well-being and skin conditions by activating a relaxation response, regulating autonomic functions, regulating immunological mechanisms, reducing scratching behaviors, altering dysfunctional habits, promoting skin healing, and improving skin comfort [19, 21]. In our population, most respondents who applied at least one relaxation technique found it to be helpful.

#### *Dietary or Nutritional Adjustments*

In our population, 75.9% of the respondents adopted a specific diet or adjusted their nutritional intake. This is in contrast with the reported low lifetime adoption of a specific diet in the literature. In a Korean cross-sectional study [49], out of 254 AD outpatients (median age 8.7 [2–40] years), 7.5% of the patients adopted a specific diet during their lifetime. Among 235 responding patients (at least 16 years old) at a Danish Dermatological University Department [50], 2.6% had “previously adopted” a specific diet. In this population [50], no patients had previously used fish oil supplements, and none had previously used probiotics. In our study population, 6.9% of the respondents had used fish oil/omega-3 fatty acid supplements and 12.1% had used probiotics. The reported lifetime use of vitamins/minerals/dietary supplements has a wide range, from 0.9% in the Danish study [50] to 24.3% in the study by Simpson et al. [45]. The frequency of use of vitamin D supplements in our population was 8.6%. Our study also found that 36.2% of the respondents restricted the consumption of refined sugar and 36.2% restricted the consumption of processed food due to AD; most found these adjustments to be helpful. Vieira et al. [48] reported that vitamin D supplementation might be a potential therapy for AD patients. In addition, smaller studies and case reports have indicated initial evidence supporting AD improvement via diet adjustments, including low-calorie diets, fasting, and vegetarian/vegan diets [22–25, 51].

Overall, 93.1% of the respondents reported adopting at least one lifestyle behavior, which might indicate a health-conscious population. Lifestyle improvements can have numerous positive effects among AD patients, especially since an association between AD and metabolic syndrome has been repeatedly discussed [13, 52, 53].

Future studies should focus on prospectively evaluating AD patients’ adoption of lifestyle behaviors over time and their benefits/harms regarding disease severity. Ac-

cordingly, prospective observational multicenter cohort studies and later prospective clinical trials should be considered. Future studies should also investigate the influence of exercise, considering its dose-response relationship with AD.

## **Conclusion**

Patients with AD in our sample often adopted health-promoting lifestyle behaviors such as exercise, relaxation techniques, and dietary or nutritional adjustments and perceived them as helpful, especially relaxation techniques and dietary or nutritional adjustments. The benefits and possible risks of the adoption of potentially healthy lifestyle behaviors by AD patients must be evaluated in high-quality cohort studies and prospective clinical trials.

## **Acknowledgements**

We thank all participants of the cross-sectional study. We also thank our study nurse, Margit Cree, and the whole team at the University Outpatient Clinic for Complementary Medicine. We thank Christina Dornquast for helping adapt the sports categories. We thank the editors at American Journal Experts for editing the article for proper English language, grammar, punctuation, spelling, and overall style (certificate verification key: 3C4F-CC78-532E-9B73-A13P).

## **Statement of Ethics**

The study was approved by the Charité Ethics Committee (CAMATOP study approval number EA1/111/17, ethics amendment for the cross-sectional study on April 16, 2019). All patients gave oral and written informed consent before their inclusion in the CAMATOP study.

## **Conflict of Interest Statement**

The authors declare no conflicts of interest regarding this study.

## **Funding Sources**

This investigator-initiated study was funded partly by the German Neurodermitis Foundation (Deutsche Neurodermitis Stiftung) and partly by the investigating institute.

## **Author Contributions**

Gabriele Rotter designed and coordinated the study, adapted the sports categories, carried out the statistical analyses, interpreted the data, and drafted the manuscript. Michael Teut designed the



study in the domain of relaxation techniques and revised the manuscript. Sylvia Binting adapted the sports categories, performed data management, carried out the statistical analyses, interpreted the data, and revised the manuscript. Andreas Michalsen revised the manuscript. Miriam Ortiz designed the study in the domain of dietary or nutritional adjustments and revised the manuscript. Benno Brinkhaus was the study director and contributed to the design and implementation of the study, interpretation of the data, and revision of the manuscript. All authors have read and approved the final version of the manuscript and agree with the order of presentation of the authors. All named authors meet the Inter-

national 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.

## Data Availability Statement

Data collected for the study will not be made available because the study participants did not explicitly consent to this.

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