


# Dermatologists' Perceptions and Factors Influencing the Selection of Topical Anti-Inflammatory Agents for Atopic Dermatitis in China: A Cross-Sectional Survey Study

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**Objective:** Topical corticosteroids (TCS), topical calcineurin inhibitors (TCI), and phosphodiesterase 4 (PDE-4) inhibitors are three common topical anti-inflammatory agents for treating atopic dermatitis (AD). The purpose of our study was to understand Chinese dermatologists' perceptions and the factors influencing their choices of the three agents.

**Methods:** An online questionnaire survey was conducted between 25 July 2022 and 25 August 2022 among Chinese dermatologists. The survey with six multiple-choice questions focused on what were their most commonly prescribed agents for treating AD, and what factors influenced their choices of the three agents. The results were assessed by chi-square test and logistic regression analysis.

**Results:** A total of 1,156 valid questionnaire replies were received. For treating AD, 79.84% of Chinese dermatologists chose TCS, 81.40% chose TCI, and 18.25% chose PDE-4 inhibitors. When TCS was not chosen, the three principal reasons included local adverse effects (85.56%), suspicious infection on lesioned area (71.54%), and patient steroid phobia (61.59%). Coincidentally, when the TCI and PDE-4 inhibitors were chosen, the main reason was patient steroid phobia (76.21% and 74.74% respectively) against TCS. When PDE-4 inhibitors were not chosen, the major reasons were their intolerable adverse effects (80.36%) and their slower onset and weak efficacy (57.61%). Logistic regression analysis revealed that more senior dermatologists were less likely to choose TCS for the reason of local adverse effects and patient steroid phobia (each  $P < 0.05$ ), they were more likely to choose TCI for the same reason of patient steroid phobia against TCS ( $P < 0.05$ ).

**Conclusion:** Local adverse effects and patient steroid phobia were the reasons that limited Chinese dermatologists from choosing TCS for treating AD. Instead, more of them choose to use TCI. PDE-4 inhibitors were sometimes considered as an alternative to TCS or TCI, but its local adverse effects and limited efficacy affected the choice of this agent.

**Keywords:** atopic dermatitis, topical anti-inflammatory agents, dermatologists, perceptions, influencing factors

## Introduction

Atopic dermatitis (AD) is a chronic, recurrent inflammatory skin disease.<sup>1,2</sup> The global prevalence rates of AD in adults are 2% to 10%, while in children are 5% to 20%.<sup>2</sup> The age-standardized prevalence of AD in China was 2.5%, and from 1990 to 2019, the number of patients with AD increased by 25.65%.<sup>3</sup> According to the Global Burden of Disease, AD ranks the 15th among all non-fatal diseases and has the greatest impact on disability-adjusted life years among all skin diseases.<sup>4,5</sup> Multiple etiologies are involved in the pathogenesis of AD including genetic background, skin barrier dysfunction, a biased T helper (Th) 2 type response, and imbalance of the skin microbiome.<sup>1,2</sup> AD's characteristics include eczema-like rashes and intense itching. It can be classified as mild, moderate, or severe based on the overall disease severity.<sup>6</sup> The Severity Scoring of Atopic Dermatitis (SCORAD) index and the Eczema Area and Severity Index (EASI) are used internationally for severity classification.<sup>7</sup>

AD requires long-term treatment and disease management, and topical anti-inflammatory agents are an important medication for all three AD severities.<sup>8</sup> The most commonly used agents include topical corticosteroids (TCS), topical calcineurin inhibitors (TCI), and topical phosphodiesterase 4 (PDE-4) inhibitors.<sup>9</sup> The guidelines for management of AD in many countries recommend TCS of sufficient potency for acute flare, with transition to moderate-to-low-potency TCS or TCI for maintenance therapy after the inflammation is controlled. PDE-4 inhibitors can be used as an alternative for TCS and TCI.<sup>6–8,10</sup> However, adverse effects may develop during the use of the three topical anti-inflammatory agents. The local adverse effects of TCS include telangiectasia, skin atrophy, depigmentation, delayed wound healing, cutaneous infection, etc, and systemic side effects may occur during long-term massive-volume application of high potency TCS in a skin-barrier-reduced state.<sup>10</sup> For TCI and PDE-4 inhibitors, the most common adverse effects are local reactions such as stinging and burning, but the symptoms tend to lessen after several applications.<sup>11,12</sup>

Due to various adverse effects and unpredictable patient compliance, dermatologists adopt different strategies for choosing topical anti-inflammatory agents, and irrational administration may occur. Therefore, we conducted a cross-sectional survey on the perceptions of dermatologists in China based on their selection of topical anti-inflammatory agents for the treatment of AD. We hope this paper provides a reference for the use of topical anti-inflammatory agents in AD.

## Methods

### Questionnaire Development

The structure and items of the questionnaire were based on literature review and expert consultation. The validity of the questionnaire was assessed by collecting opinions of experts both in dermatology field and statistics field. The questionnaire was developed after three rounds of interviews and revisions. A pilot test was conducted among dermatologists in Peking University People's Hospital, Beijing, China. In the questionnaire, there were six questions about demographic information regarding age, professional title, hospital grade, license type, working at AD specialty clinics, and outpatient volume per week. Six questions of multiple-choice regarding the perceptions and influencing factors for dermatologists to choose topical anti-inflammatory agents for AD are shown in [Table 1](#).

**Table 1** Survey Questions of Chinese Dermatologists' Perceptions and Influencing Factors Toward Selecting Topical Anti-Inflammatory Agents for Atopic Dermatitis

Questions	Options
(1) What are your most commonly prescribed topical anti-inflammatory agents?	A. TCS B. TCI C. PDE-4 inhibitors D. Others
(2) What factors made you less likely to choose TCS?	A. Local adverse effects such as telangiectasia, skin atrophy, and depigmentation B. Systemic adverse effects C. Suspicious infection on lesions D. Steroid phobia in patients E. Systemic therapy is effective
(3) What factors made you more likely to choose TCI?	A. Lesions on face/sensitive areas B. Steroid phobia in patients C. Children aged 3–18 year-old D. Maintenance therapy E. Sequential therapy following TCS

(Continued)

**Table I** (Continued).

Questions	Options
(4) What factors made you less likely to choose TCI	A. Risk for cancer B. Effectiveness of TCS C. Limited effects for maintenance D. Infants or pregnant women E. Preference for PDE-4 inhibitors
(5) What factors made you more likely to choose PDE-4 inhibitors?	A. Mild or moderate AD B. Steroid phobia in patients C. Children aged 3–18 year-old D. Intolerable side effects of TCI E. TCS was more effective
(6) What factors made you less likely to choose PDE-4 inhibitors?	A. Intolerable adverse effects of PDE-4 inhibitors B. TCS or TCI was effective C. Limited effects for maintenance D. Slower onset and weak efficacy E. Infants and pregnant women.

## Study Participants and Data Collection

The questionnaire was shared on the Umer platform, an online learning and communication platform for dermatologists in China. Data was collected between 25 July 2022 and 25 August 2022. Inclusion criteria: (1) dermatologists with medical license who worked in public medical institutions, (2) questionnaire being completely answered. Exclusion criteria: (1) questionnaire with illogical answers, (2) questionnaire being finished in less than 300 seconds.

## Statistical Analysis

All variables were analyzed using SPSS 27.0 software. Count data were expressed as n (%). Factors analyzed included all respondent characteristics (age, professional title, hospital grade, license type, working at an AD specialty clinic, and outpatient volume per week). Chi-square test was performed for univariate analysis. The variables with  $P < 0.05$  were then analyzed by multivariate logistic regression analysis.  $P < 0.05$  indicates a statistically significant difference.

## Results

### Participant Characteristics

A total of 1,386 questionnaires were received, and 1,156 were accepted as valid for the survey. The characteristics of the dermatologists are shown in [Table 2](#).

### Dermatologists' Choices of Topical Anti-Inflammatory Agents for AD

Among 1156 surveyed dermatologists, 923 (79.84%) chose TCS, 941 (81.40%) chose TCI, and 211 (18.25%) chose PDE-4 inhibitors to treat AD. The choice of TCS was influenced by professional title, license type, and weekly outpatient volume ( $P < 0.01$  or 0.001); the choice of TCI was influenced by age, professional title, and weekly outpatient volume ( $P < 0.01$ ); and the choice of PDE-4 inhibitors was influenced by professional title, hospital grade, license type, working at AD specialty clinics and weekly outpatient volume ( $P < 0.05$ , 0.01, or 0.001). ([Table 3](#))

Logistic regression analysis showed that compared with chief physicians, junior residents were less likely to choose TCS ( $OR=0.33$ , 95% confidence interval (CI): 0.13–0.85,  $P=0.020$ ). Dermatologists in the department of traditional Chinese medicine/integrated traditional Chinese and Western medicine were less likely to choose TCS than those in the department of Western medicine ( $OR=0.62$ , 95% CI: 0.46–0.83,  $P=0.001$ ). Compared with dermatologists working at AD specialty clinics, dermatologists who do not have such specialty clinics were less likely to choose PDE-4 inhibitors ( $OR=0.55$ , 95% CI: 0.38–0.79,  $P=0.001$ ).

**Table 2** Characteristics of 1, 156 Dermatologists

Characteristic	Case	%
<b>Age/year</b>		
≤30	252	21.80
31–40	497	42.99
41–50	280	24.22
>50	127	10.99
<b>Professional title</b>		
Junior resident	121	10.47
Senior resident	315	27.25
Attending physician	445	38.49
Associate chief physician	204	17.65
Chief physician	71	6.14
<b>Hospital grade</b>		
Grade-1	48	4.15
Grade-2	343	29.67
Grade-3	765	66.18
<b>License type</b>		
Western medicine	713	61.68
Traditional Chinese medicine or integrated	443	38.32
<b>Working at AD specialty clinics</b>		
Yes	191	16.52
No	965	83.48
<b>Weekly outpatient volume/person-time</b>		
0–99	425	36.76
100–199	386	33.39
200–299	222	19.20
300–399	83	7.18
≥400	40	3.46

**Table 3** Dermatologists' Selection of Topical Anti-Inflammatory Agents for AD [Case (%)]

Characteristic	TCS			TCI			PDE-4 inhibitor		
	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P
<b>Age/year</b>									
≤30	197(78.17)	1.96	0.58	196(77.78)	11.52	0.009	57(22.62)	5.86	0.119
31–40	396(79.68)			393(79.07)			91(18.31)		
41–50	231(82.50)			245(87.50)			46(16.43)		
>50	99(77.95)			107(84.25)			17(13.39)		
<b>Professional title</b>									
Junior resident	76(62.81)	24.96	<0.001	86(71.07)	15.42	0.004	35(28.93)	14.58	0.006
Senior resident	256(81.27)			251(79.68)			61(19.37)		
Attending physician	367(82.47)			365(82.02)			64(14.38)		
Associate chief physician	168(82.35)			175(85.78)			40(19.61)		
Chief physician	56(78.87)			64(90.14)			11(15.49)		
<b>Hospital grade</b>									
Grade-1	40(83.33)	0.38	0.826	39(81.25)	1.89	0.389	6(12.5)	10.76	0.005
Grade-2	273(79.59)			271(79.01)			45(13.12)		
Grade-3	610(79.74)			631(82.48)			160(20.92)		
<b>License type</b>									
Western medicine	591(82.89)	10.72	0.001	593(83.17)	3.84	0.050	146(20.48)	6.17	0.013
Traditional Chinese medicine or integrated	332(74.94)			348(78.56)			65(14.67)		

(Continued)

Table 3 (Continued).

Characteristic	TCS			TCI			PDE-4 inhibitor		
	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P
<b>Working at AD specialty clinics</b>		0.24	0.622		1.76	0.184		18.78	<0.001
Yes	155(81.15)			162(84.82)			56(29.32)		
No	768(79.59)			779(80.73)			155(16.06)		
<b>Weekly outpatient volume/person-time</b>		24.90	<0.001		14.67	0.005		17.21	0.002
0–99	310(72.94)			326(76.71)			74(17.41)		
100–199	321(83.16)			321(83.16)			62(16.06)		
200–299	189(85.14)			185(83.33)			38(17.12)		
300–399	74(89.16)			77(92.77)			29(34.94)		
≥400	29(72.50)			32(80.00)			8(20.00)		

### Factors That Influence Dermatologists Not to Choose TCS

Among the surveyed dermatologists who were less likely to choose TCS, 989 (85.56%) did not choose for the reason of local adverse effects, with age, professional title, and license type as influencing factors ( $P < 0.05$  or  $0.001$ ). A total of 827 (71.54%) did not choose for the reason of suspected infection on lesioned area, with no significant difference among dermatologists. And 712 (61.59%) did not choose because of patient steroid phobia, with professional title and hospital grade as influencing factors ( $P < 0.05$  or  $0.01$ ). (Table 4)

Logistic regression analysis showed that compared with junior residents, chief physicians, associate chief physicians, attending physicians, and senior residents had a higher probability of not choosing TCS because of local adverse effects ( $OR=4.11$ , 95% CI: 1.31–12.90,  $P=0.016$ ;  $OR=2.99$ , 95% CI: 1.38–6.51,  $P=0.006$ ;  $OR=4.36$ , 95% CI: 2.33–8.19,  $P<0.001$ ;  $OR=3.48$ , 95% CI: 2.05–5.92,  $P<0.001$ ). Dermatologists in traditional Chinese medicine/integrated traditional Chinese and Western medicine department had a lower probability of not choosing TCS because of adverse effects than those in Western medicine department ( $OR=0.62$ , 95% CI: 0.44–0.87,  $P=0.006$ ). Compared with junior residents, chief physicians, associate chief physicians, attending physicians, and senior residents had a higher probability of not choosing TCS because of patient steroid phobia ( $OR=1.95$ , 95% CI: 1.05–3.62,  $P=0.034$ ;  $OR=2.25$ , 95% CI: 1.39–3.64,  $P=0.001$ ;  $OR=2.17$ , 95% CI: 1.43–3.31,  $P<0.001$ ;  $OR=1.55$ , 95% CI: 1.01–2.37,  $P=0.046$ ). Compared with dermatologists in grade-1 hospitals, those in grade-3 hospitals had a higher probability ( $OR=2.17$ , 95% CI: 1.20–3.94,  $P=0.011$ ) of not choosing TCS because of patient steroid phobia.

### Factors for Dermatologists to Choose TCI

Among the surveyed dermatologists, 1000 (86.51%) chose TCI because of lesions on face/sensitive areas, with no significant difference among dermatologists. A total of 881 (76.21%) chose TCI because of patient steroid phobia, with age and professional title as influencing factors ( $P < 0.001$ ). (Table 5)

Logistic regression analysis showed that compared with junior residents, chief physicians, associate chief physicians, attending physicians, and senior residents had a higher probability of choosing TCI because of patient steroid phobia ( $OR=2.88$ , 95% CI: 1.09–7.63,  $P=0.033$ ;  $OR=3.23$ , 95% CI: 1.61–6.49,  $P=0.001$ ;  $OR=2.48$ , 95% CI: 1.43–4.30,  $P=0.001$ ;  $OR=1.64$ , 95% CI: 1.03–2.61,  $P=0.036$ ).

### Factors for Dermatologists Not to Choose TCI

Among the surveyed dermatologists, 967 (83.65%) did not choose TCI for infants or pregnant women, with no significant difference. A total of 820 (70.93%) did not choose due to the belief that TCS was more effective, with age, professional title, license type, working at AD specialty clinics, and weekly outpatient volume as influencing factors ( $P < 0.05$  or  $0.01$ ) (Table 6). In addition, 785 dermatologists (67.91%) did not choose TCI due to limited effects for maintenance.

Logistic regression analysis showed that compared with junior residents, chief physicians, and attending physicians had a lower probability of not choosing TCI due to the better efficacy of TCS ( $OR=0.42$ , 95% CI: 0.18–0.97,  $P=0.042$ ;  $OR=0.57$ , 95% CI: 0.33–0.78,  $P=0.042$ ). Dermatologists in traditional Chinese medicine/integrated traditional Chinese

**Table 4** Factors for Dermatologists Not to Choose TCS [Case (%)]

Characteristic	Local Adverse Effects			Suspicious Infection on Lesions			Steroid Phobia in Patients		
	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P
<b>Age/year</b>		15.14	0.002		6.31	0.098		2.07	0.559
≤30	200(79.37)			166(65.87)			146(57.94)		
31–40	423(85.11)			359(72.23)			309(62.17)		
41–50	255(91.07)			204(72.86)			175(62.50)		
>50	111(87.40)			98(77.17)			82(64.57)		
<b>Professional title</b>		43.25	<0.001		5.80	0.215		17.91	0.001
Junior resident	80(66.12)			77(63.64)			57(47.11)		
Senior resident	270(85.71)			228(72.38)			182(57.78)		
Attending physician	396(88.99)			318(71.46)			291(65.39)		
Associate chief physician	179(87.75)			148(72.55)			136(66.67)		
Chief physician	64(90.14)			56(78.87)			46(64.79)		
<b>Hospital grade</b>		2.74	0.254		2.74	0.254		6.66	0.036
Grade-1	45(93.75)			36(75.00)			23(47.92)		
Grade-2	293(85.42)			234(68.22)			201(58.60)		
Grade-3	651(85.10)			557(72.81)			488(63.79)		
<b>License type</b>		6.67	0.010		0.30	0.584		0.05	0.818
Western medicine	625(87.66)			506(70.97)			441(61.85)		
Traditional Chinese medicine or integrated	364(82.17)			321(72.46)			271(61.17)		
<b>Working at AD specialty clinics</b>		0.66	0.418		0.04	0.950		0.35	0.553
Yes	167(87.43)			137(71.73)			114(59.69)		
No	822(85.18)			690(71.50)			598(61.97)		
<b>Weekly outpatient volume/person-time</b>		5.91	0.206		0.22	0.994		12.06	0.017
0–99	351(82.59)			302(71.06)			239(56.24)		
100–199	332(86.01)			277(71.76)			253(65.54)		
200–299	197(88.74)			161(72.52)			134(60.36)		
300–399	74(89.16)			59(71.08)			60(72.29)		
≥400	35(87.50)			28(70.00)			26(65.00)		

**Table 5** Factors for Dermatologists to Choose TCI [Case (%)]

Characteristic	Face/Sensitive Area			Steroid Phobia in Patients		
	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P
<b>Age/year</b>		4.00	0.261		26.67	<0.001
≤30	214(84.92)			165(65.48)		
31–40	435(87.53)			378(76.06)		
41–50	247(88.21)			231(82.50)		
>50	104(81.89)			107(84.25)		
<b>Professional title</b>		7.79	0.099		40.35	<0.001
Junior resident	96(79.34)			71(58.68)		
Senior resident	272(86.35)			222(70.48)		
Attending physician	396(88.99)			355(79.78)		
Associate chief physician	175(85.78)			173(84.80)		
Chief physician	61(85.92)			60(84.51)		
<b>Hospital grade</b>		4.96	0.084		1.73	0.420
Grade-1	40(83.33)			39(81.25)		
Grade-2	286(83.38)			254(74.05)		
Grade-3	674(88.10)			588(76.86)		

(Continued)

Table 5 (Continued).

Characteristic	Face/Sensitive Area			Steroid Phobia in Patients		
	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P
<b>License type</b>		0.86	0.356		2.62	0.106
Western medicine	622(87.24)			532(74.61)		
Traditional Chinese medicine or integrated	378(85.33)			349(78.78)		
<b>Working at AD specialty clinics</b>		0.17	0.681		1.98	0.160
Yes	167(87.43)			138(72.25)		
No	833(86.32)			743(77.00)		
<b>Weekly outpatient volume/person-time</b>		1.95	0.745		9.87	0.198
0–99	363(85.41)			312(73.41)		
100–199	334(86.53)			305(79.02)		
200–299	198(89.19)			170(76.58)		
300–399	71(85.54)			69(83.13)		
≥400	34(85.00)			25(62.50)		

Table 6 Factors for Dermatologists Not to Choose TCI [Case (%)]

Characteristic	Infants or Pregnant Women			Effective by Using TCS		
	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P
<b>Age/year</b>		7.07	0.070		8.47	0.037
≤30	165(65.48)			162(64.29)		
31–40	347(69.82)			287(57.75)		
41–50	212(75.71)			152(54.29)		
>50	92(72.44)			84(66.14)		
<b>Professional title</b>		7.05	0.134		11.17	0.025
Junior resident	87(71.90)			81(66.94)		
Senior resident	208(66.03)			198(62.86)		
Attending physician	317(71.24)			241(54.16)		
Associate chief physician	156(76.47)			127(62.25)		
Chief physician	48(67.61)			38(53.52)		
<b>Hospital grade</b>		0.89	0.641		1.55	0.460
Grade-1	36(75.00)			32(66.67)		
Grade-2	246(71.72)			207(60.35)		
Grade-3	534(69.80)			446(58.30)		
<b>License type</b>		0.94	0.333		9.85	0.002
Western medicine	496(69.57)			397(55.68)		
Traditional Chinese medicine or integrated	320(72.23)			288(65.01)		
<b>Working at AD specialty clinics</b>		0.70	0.402		10.58	0.001
Yes	130(68.06)			93(48.69)		
No	686(71.09)			592(61.35)		
<b>Weekly outpatient volume/person-time</b>		2.30	0.681		20.20	<0.001
0–99	296(69.65)			264(62.12)		
100–199	271(72.80)			241(62.44)		
200–299	160(72.07)			129(58.11)		
300–399	57(68.67)			32(38.55)		
≥400	32(80.00)			19(47.50)		

and Western medicine department ( $OR=1.41$ , 95% CI: 1.10–1.81,  $P=0.007$ ) and dermatologists not working at AD specialty clinics ( $OR=1.63$ , 95% CI: 1.18–2.26,  $P=0.003$ ) had a higher probability of not choosing TCI due to the better efficacy of TCS.

## Factors for Dermatologists to Choose PDE-4 Inhibitors

Among the surveyed dermatologists who were more likely to choose PDE-4 inhibitors, 864 (74.74%) chose PDE-4 inhibitors due to patient steroid phobia for TCS, with age and professional title as influencing factors ( $P<0.05$ ). A total of 669 (57.87%) chose PDE-inhibitors due to intolerable side effects of TCI, with age and professional title as influencing factors ( $P<0.05$ ). (Table 7)

Logistic regression analysis showed that compared with chief physicians, junior residents had a lower probability of choosing PDE-4 inhibitors because of intolerable side effects of TCI ( $OR=0.42$ , 95% CI: 0.18–0.97,  $P=0.041$ ).

## Factors for Dermatologists Not to Choose PDE-4 Inhibitors

Among the surveyed dermatologists who were less likely to choose PDE-4 inhibitors, 929 (80.36%) did not choose them due to intolerable adverse effects of PDE-4 inhibitors, with professional title as an influencing factor ( $P<0.05$ ). A total of 780 (67.47%) did not choose them due to the good efficacy of TCS or TCI, with licensed type as an influencing factor ( $P<0.05$ ) (Table 8). In addition, 666 dermatologists (57.61%) were not likely to choose PDE-4 inhibitors due to slower onset and weaker efficacy.

**Table 7** Factors for Dermatologists to Choose PDE-4 Inhibitor [Case (%)]

Characteristic	Steroid Phobia in Patients			Intolerable Side Effects of TCI		
	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P
<b>Age/year</b>		16.02	0.001		10.63	0.014
≤30	168(66.67)			136(53.97)		
31–40	370(74.45)			277(55.73)		
41–50	220(78.57)			167(59.64)		
>50	106(83.46)			89(70.08)		
<b>Professional title</b>		17.43	0.002		15.64	0.004
Junior resident	78(64.46)			56(46.28)		
Senior resident	223(70.79)			178(56.51)		
Attending physician	339(76.18)			265(59.55)		
Associate chief physician	163(79.90)			117(57.35)		
Chief physician	61(85.92)			53(74.65)		
<b>Hospital grade</b>		1.19	0.550		0.39	0.821
Grade-1	34(70.83)			29(60.42)		
Grade-2	251(73.18)			202(58.90)		
Grade-3	579(75.69)			438(57.25)		
<b>License type</b>		0.02	0.878		0.01	0.939
Western medicine	534(74.89)			412(57.78)		
Traditional Chinese medicine or integrated	330(74.49)			257(58.01)		
<b>Working at AD specialty clinics</b>		0.47	0.494		0.17	0.693
Yes	139(72.77)			113(59.16)		
No	725(75.13)			556(57.62)		
<b>Weekly outpatient volume/person-time</b>		3.01	0.556		2.52	0.641
0–99	306(72.00)			235(55.29)		
100–199	293(75.91)			232(60.10)		
200–299	170(76.58)			129(58.11)		
300–399	63(75.90)			51(61.45)		
≥400	32(80.00)			22(55.00)		

**Table 8** Factors for Dermatologists Not to Choose PDE-4 Inhibitors [Case (%)]

Characteristic	Intolerable Adverse Effects of PDE-4 Inhibitors			Effective by Using TCS or TCI		
	Case (%)	$\chi^2$	P	Case (%)	$\chi^2$	P
<b>Age/year</b>		4.19	0.242		2.91	0.406
≤30	210(83.33)			170(67.46)		
31–40	402(80.89)			329(66.20)		
41–50	222(79.29)			187(66.79)		
>50	95(74.80)			94(74.02)		
<b>Professional title</b>		13.42	0.009		1.51	0.825
Junior resident	97(80.17)			82(67.77)		
Senior resident	261(82.86)			215(68.25)		
Attending physician	365(82.02)			296(66.52)		
Associate chief physician	160(78.43)			135(66.18)		
Chief physician	46(64.79)			52(73.24)		
<b>Hospital grade</b>		0.75	0.686		1.29	0.524
Grade-1	40(83.33)			36(75.00)		
Grade-2	271(79.01)			230(67.06)		
Grade-3	618(80.78)			514(67.19)		
<b>License type</b>		1.14	0.286		5.46	0.019
Western medicine	580(81.35)			463(64.94)		
Traditional Chinese medicine or integrated	349(78.78)			317(71.56)		
<b>Working at AD specialty clinics</b>		1.20	0.273		0.24	0.627
Yes	148(77.49)			126(65.97)		
No	781(80.93)			654(67.77)		
<b>Weekly outpatient volume/person-time</b>		2.73	0.603		2.74	0.602
0–99	342(80.47)			292(68.71)		
100–199	304(78.76)			257(66.58)		
200–299	185(83.33)			153(68.92)		
300–399	68(81.93)			50(60.24)		
≥400	30(75.00)			28(70.00)		

## Discussion

TCS has been used as a topical anti-inflammatory agent for AD since 1950s, and plays a critical role in the treatment of AD.<sup>13,14</sup> However, TCS can cause both local and systemic adverse effects as well as patient steroid phobia. With the advances in pharmaceutical research, new topical anti-inflammatory agents have been developed. TCI, specifically, does not show side effects such as skin atrophy, telangiectasia, and pigmentation, and can be applied as a first-line agent for face and sensitive areas, or as sequential therapy following TCS for long-term maintenance treatment.<sup>8,15</sup> Similarly, PDE-4 inhibitor is a novel small-molecule agent that demonstrates a lower probability of skin irritation compared to TCI, making it more acceptable to patients.<sup>16–18</sup>

Our study shows that the primary reasons for dermatologists not to choose TCS were due to local adverse effects and patient steroid phobia. Dermatologists with more senior professional titles, in Western medicine departments, and in grade-3 hospitals had a higher probability of not choosing TCS for the above two reasons. TCS is a first-line agent for the treatment of AD. But despite its adequate anti-inflammatory effects, it remains controversial due to its adverse effects. Patients and their family members may have concern about the adverse effects of TCS, with percentages ranging from 21.0% to 83.7%.<sup>19,20</sup> However, an umbrella review showed that the short-term use of TCS during the flare of AD or during intermission between flares did not result in significant local adverse effects.<sup>21</sup> Steroid phobia is an important factor for the decline in patient compliance, leading to treatment failure by TCS and causing dermatologists to alter their prescription, there is still no effective solution for steroid phobia, and even attempts to increase patients' understanding of TCS do not reduce their fears.<sup>22</sup> The above results suggest dermatologists in China are still cautious toward TCS, especially those experienced in treating AD. Ultimately, patient steroid phobia is an obstacle for TCS that has yet to be overcome.

This study showed that TCI (81.40%) has surpassed TCS (79.84%) in popularity and has become the most preferred topical anti-inflammatory agent for dermatologists to treat AD in China. The principal reasons for dermatologists to choose TCI included lesions on the face/sensitive areas (being more prone to the adverse effects of TCS) and patient steroid phobia for TCS. TCI did not cause adverse effects such as skin atrophy and telangiectasia as TCS, and the most common adverse effects of TCI were temporary burning or itching.<sup>19,23</sup> However, considering that TCS showed adequate effects, while TCI had limited maintenance effects, some dermatologists did not choose TCI. The above results reflected the difficult decision for Chinese dermatologists to choose between TCS and TCI. On the one hand, they recognized the efficacy of TCS, but on the other, they were more likely to choose TCI to avoid local adverse effects and patient steroid phobia.

Similarly, dermatologists were more likely to choose PDE-4 inhibitor due to patient steroid phobia and TCI intolerance. The proportion of dermatologists who chose PDE-4 inhibitor was higher in those who work at AD specialty clinics, which is likely due to greater awareness and accessibility to new AD treatment agents. However, dermatologists were also less likely to choose PDE-4 inhibitor due to their slower onset and weaker efficacy compared to TCS and TCI. Currently, there are limited studies comparing the efficacy of PDE-4 inhibitors with other topical anti-inflammatory agents. A meta-analysis by Fahrbach et al showed that topical PDE-4 inhibitors were more effective than 1% pimecrolimus ointment and showed equivalent efficacy to 0.1% or 0.03% tacrolimus ointment.<sup>24</sup> Clinical trials comparing the efficacy of PDE-4 inhibitors with TCS are under-reported. The study by Draelos et al showed that the incidence of local adverse effects of PDE-4 inhibitors, including skin sensation of burning, tingling, and itching, was lower than that of TCI but higher than that of TCS.<sup>25</sup> The efficacy and adverse effects of PDE-4 inhibitors remain to be investigated in the real world.

## Limitations

This study's limitations were mainly reflected in the fact that the questionnaires were online and a non-probability sampling method was adopted. The Umer platform where the questionnaires were conducted requires registration and authentication for use. Those who were not registered with the platform did not have a chance to take the survey. Even the registered users did not all participate. Therefore, the survey may not sufficiently represent the entire population of Chinese dermatologists. Secondly, the perceptions and choices of dermatologists from different regions in China were not analyzed. Therefore, regional variations were not included in this study.

## Conclusions

In conclusion, our study showed that dermatologists in China hold different perceptions on topical anti-inflammatory agents for treating AD, which influenced their prescription strategy. Local adverse effects and patient steroid phobia were the main reasons which limited Chinese dermatologists from choosing TCS. Instead, more of them chose to use TCI for the treatment of AD. Besides, Chinese dermatologists were willing to try PDE-4 inhibitors as an alternative agent to TCS or TCI, but local adverse effects and limited efficacy affected their choice of this relatively new medicine. Our study contributes to the understanding of Chinese dermatologists' perceptions and factors influencing their selection of topical anti-inflammatory agents for AD. It reveals that steroid phobia is still an obstacle in the use of TCS, for which we suggest further research for a more effective solution. As to the new agent PDE-4 inhibitors, we recommend gathering more empirical data from wider clinical practices to gain deeper insight of the medicine.

## Ethics Statement

This study was approved by the Ethics Committee of the Peking University People's Hospital. All participants provided informed consent before participating in the study. The study was conducted in compliance with the Declaration of Helsinki.

## Acknowledgments

We appreciate the Umer platform for posting the questionnaire.

## Disclosure

The authors report no conflicts of interest in this work.

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