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ORIGINAL RESEARCH

Comparison of Systemic Corticosteroid Therapy Practices Between Pediatric and Adult Rheumatologists: A Multicenter Survey Study

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ABSTRACT

***Introduction*:** The indications, dosage, and duration of systemic corticosteroid treatment may vary among pediatric rheumatologists (PRs) and adult rheumatologists (ARs) in daily clinical practice. This study aims to evaluate and compare practices, perceptions, and attitudes of PRs and ARs regarding the use of systemic corticosteroids.

***Methods*:** An online survey was administered to rheumatologists in Türkiye to assess their use of systemic corticosteroids in the management of rheumatic diseases. The questionnaire addressed preferred corticosteroid formulations, dosing and tapering strategies, monitoring and preventive measures for adverse effects, and vaccination practices.

***Results*:** Sixty PRs and 40 ARs participated in the study. Prednisolone was most commonly preferred by PRs while almost all ARs used methylprednisolone. Weight-based dosing was favored by PRs whereas ARs preferred fixed-dose regimens. PRs more frequently preferred longer pulse corticosteroid therapy, whereas ARs most commonly used a 3-day pulse regimen. In contrast, ARs reported significantly longer durations of bridging and maintenance therapy. Delirium was reported significantly more often by ARs as a complication ($p=0.026$). In pre-treatment evaluation, PRs more commonly assessed peripheral blood smear ($p<0.001$) whereas ARs more frequently screened for hepatitis serology ($p=0.014$). As preventive strategies, PRs were significantly more likely to request ophthalmologic examination ($p=0.005$). Immunization assessment for meningococcal, measles—mumps—rubella, and varicella vaccines was significantly more common among PRs ($p>0.005$, for all).

***Conclusion*:** Significant heterogeneity exists between PRs and ARs in systemic corticosteroids practices, highlighting the need for age-specific standardized protocols for dosing, preventive strategies, and complication monitoring.

Graphical abstract available for this article.

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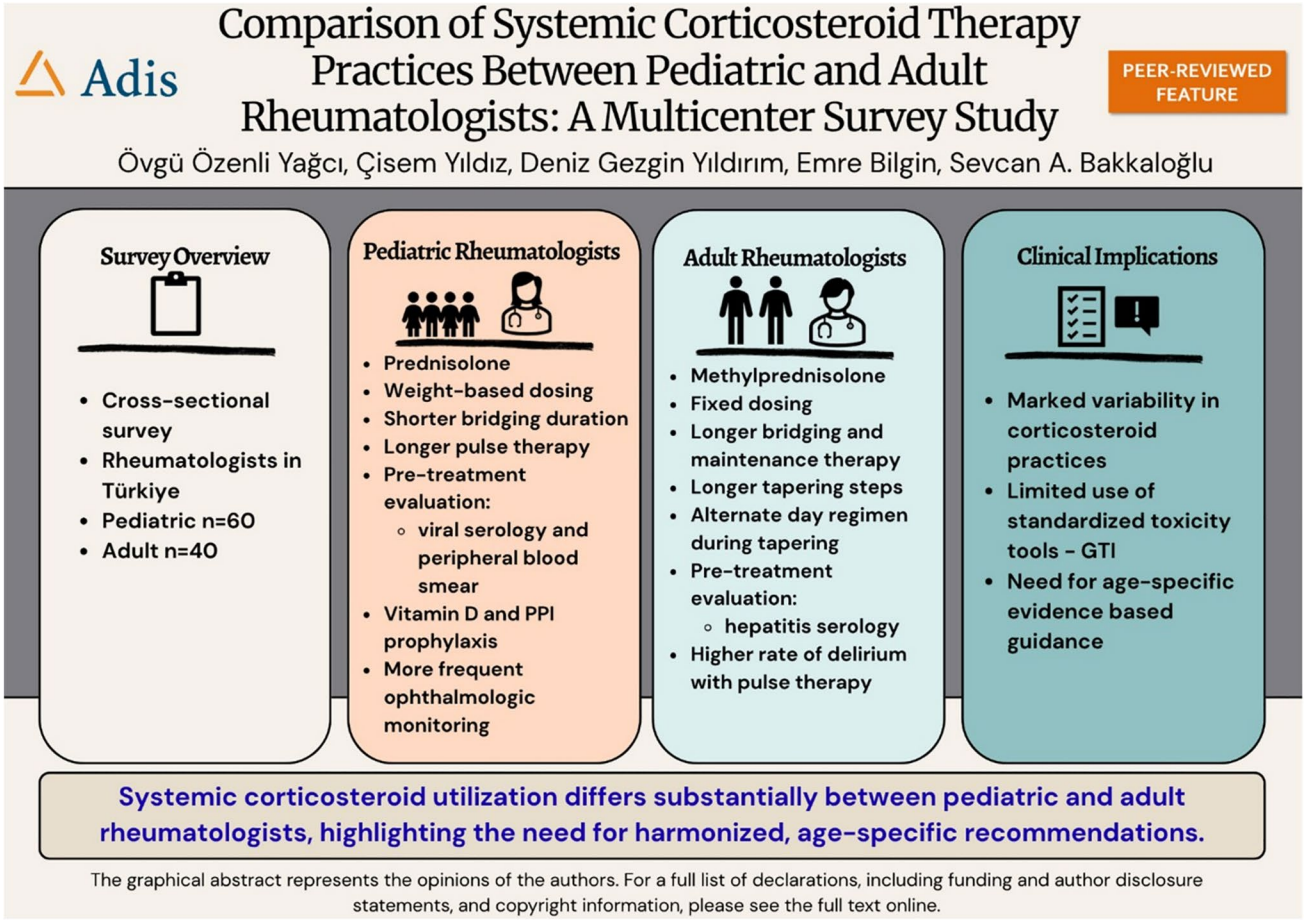
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Key Summary Points

Why carry out this study?

Systemic corticosteroids are widely used across rheumatic diseases despite well-known toxicity and contradictory guidance on optimal dosing, duration, and monitoring.

Prescribing patterns in clinical practice vary substantially and comparative data on corticosteroid practices between pediatric and adult rheumatologists are lacking.

What was learned from the study?

There is heterogeneity in perception, attitude, and approach among pediatric and adult rheumatologists at every aspect of systemic corticosteroid utilization including formulation choice, dosing and tapering strategies, pulse, bridging, and maintenance practices, as well as preventive measures, monitoring complications, and vaccination assessments.

These findings underscore the need for standardized, evidence-based, and age-specific recommendations to optimize corticosteroid use.

DIGITAL FEATURES

This article is published with digital features, including graphical abstract, to facilitate understanding of the article. To view digital features for this article, go to https://doi.org/10.6084/m9.figshare.32551263

INTRODUCTION

Synthetic corticosteroids are analogues of endogenous adrenal corticosteroids, which include glucocorticoids and mineralocorticoids. Glucocorticoids have metabolic, anti-inflammatory, and immunomodulatory effects, whereas mineralocorticoids primarily regulate electrolyte and water balance in the body [1]. Structurally resembling endogenous glucocorticoids, therapeutic corticosteroids are primarily used for their potent anti-inflammatory and immunosuppressive actions in various rheumatic diseases, including connective tissue diseases, vasculitides, and autoinflammatory diseases. The anti-inflammatory effects of systemic corticosteroids are primarily mediated through trans-repression, which downregulates pro-inflammatory signaling cascades that involve tumor necrosis factor alpha (TNF-α), interferon-γ, and key effectors in synovial, cartilage, and bone damage, such as interleukin-1 (IL-1), IL-2, IL-3, and IL-17. In addition, glucocorticoids stimulate the production of anti-inflammatory factors such as IkB (an inhibitor of NF-kB), IL-10, and IL-1 receptor antagonists (IL-1RAs) [2].

Since their discovery, therapeutic corticosteroids have remained a cornerstone in the management of numerous inflammatory and autoimmune diseases [3]. Despite the development of conventional disease-modifying anti-rheumatic drugs (cDMARDs) and biological DMARDs (bDMARDs), corticosteroids remain fundamental to routine rheumatologic practice owing to their rapid and reliable "bridge" efficacy [4]. Multiple corticosteroid formulations are available for both intravenous and oral administration, differing in their relative glucocorticoid and mineralocorticoid effects [5].

However, this clinical reliance comes at a significant cost; corticosteroids are associated with significant adverse effects, particularly with long-term use in both children and adults. The type and severity of these effects depend on the dose and duration of therapy, and can include osteonecrosis, osteoporosis, hyperglycemia, hypertension, cardiovascular disease, gastric ulceration, increased infection risk, impaired wound healing, cataracts, adrenal suppression, psychiatric disturbances, and weight gain [2]. In children, growth suppression and delayed puberty represent additional concerns for pediatric rheumatologists (PRs) [3]. Childhood-onset rheumatic diseases are often more severe, present with more aggressive manifestations, and may require earlier, more intensive, and prolonged corticosteroid therapy [6]. To minimize toxicity, preexisting risk factors should be evaluated before initiating treatment, and appropriate preventive measures

implemented. The glucocorticoid toxicity index (GTI) has been developed as a validated tool to assess morbidity associated with long-term corticosteroid exposure [6].

Despite the ubiquitous role of glucocorticoids in rheumatology practice, approaches to their initiation, tapering, and monitoring of adverse effects vary considerably between PRs and adult rheumatologists (ARs). To date, no published studies have systematically evaluated corticosteroid utilization in routine clinical practice among PRs and ARs. Therefore, the aim of this study is to evaluate and compare practices, perceptions, and attitudes of PRs and ARs regarding the use of systemic corticosteroid therapy in rheumatic diseases.

METHODS

Study Design

A voluntary, nationwide, web-based survey was conducted from July to September 2025 among PRs and ARs to collect data on their clinical practices and perspectives regarding systemic corticosteroid treatment.

Study Description

The questionnaire, designed by two authors (one PR and one AR) following an extensive review of relevant literature on corticosteroid therapy in rheumatic diseases, included total of 35 questions; yes/no or multiple-choice formats and open-ended questions (Supplementary material 1). Prior to main study, a pilot test was conducted with a small number of participants to ensure clarity and readability of the survey. Multiple aspects of corticosteroid use were questioned including preferred formulations, dosing regimens, duration, and tapering strategies for corticosteroids as pulse, bridging, and maintenance treatment. In addition, the occurrence of adverse effects and preventive measures implemented to mitigate corticosteroid-related complications were evaluated, along with laboratory assessments and vaccination practices prior to treatment initiation. The survey also assessed the utilization of GTI, a weighted scoring system designed particularly for patients to quantify both worsening and improvement in glucocorticoid toxicity [6].

Target Population and Sampling

The questionnaire link was distributed via electronic mail to PRs and ARs across Türkiye. The theme and objectives of the study were explained on the first page of the survey. Among the 310 clinicians contacted, a total of 100 specialists, 60 PRs and 40 ARs, responded to the survey.

Data Analysis

SPSS version 21 software (SPSS, Chicago, USA) was used to analyze the data. Descriptive statistics were reported as numbers (n) and percentages (%). Data distribution was evaluated using the Shapiro–Wilk test. Variables were reported as mean ± SD or median [interquartile range (IQR)] according to the data distribution. The independent-sample t test was used to compare the differences between two independent groups for variables with normal distribution, while the Mann–Whitney U test was used for non-normally distributed variables. Group characteristics were compared using Fisher's exact test or the chi-square test, as appropriate. A p value < 0.05 was considered statistically significant.

Ethical Approval

The survey was kept anonymous and encrypted. Electronic informed consent was obtained from all participants on the first page of the web-based survey before they could proceed to the questions. The present study was conducted in accordance with the Declaration of Helsinki and approved by the local ethics committee of the Gazi University Medical Faculty (Decision number E-77082166-604.01-1287324/2025-1247 dated 14.07.2025). All participants consented to participate in the survey study.

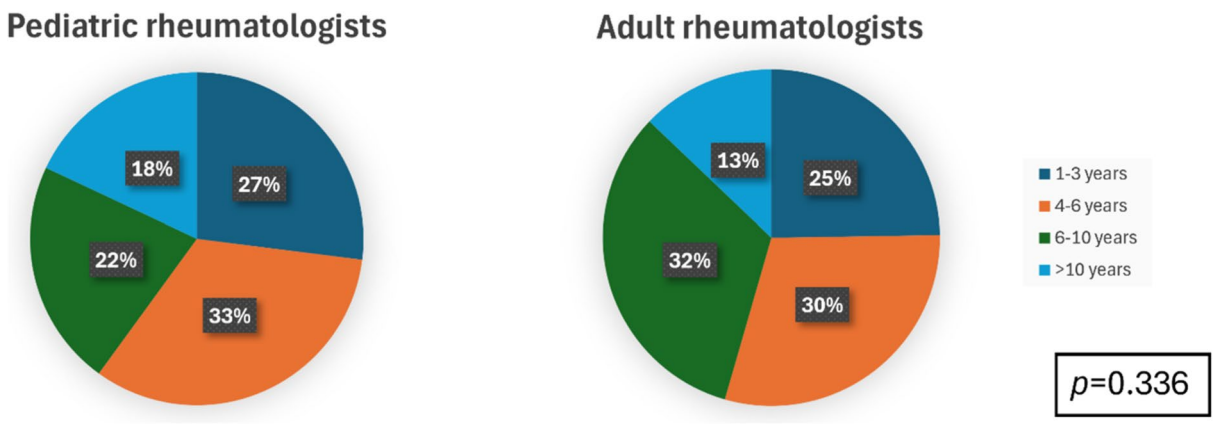


Fig. 1 Distribution of professional experience among pediatric and adult rheumatologists. Professional experience distribution was similar between pediatric and adult rheumatologists, with no significant difference across years of practice ($p = 0.336$)

RESULTS

Overall, 100 specialists (60 PRs, 40 ARs) participated in the study, with a median age of 38 years (IQR 36–42). No significant differences were observed between the groups with respect to clinicians' age or years of professional experience (Fig. 1).

Daily Systemic Corticosteroid Usage Practices

Table 1 provides an overview of clinicians' approaches to oral corticosteroid use and pulse methylprednisolone (MP) treatment. Prednisolone was the most frequently prescribed oral corticosteroid formulation among PRs, with no significant difference compared to ARs ($p=0.374$). In contrast, ARs preferred MP significantly more often than PRs ($p=0.002$). The most commonly administered maximum daily dose of oral prednisolone in both groups was 60 mg/day, with a higher proportion among PRs compared to ARs (91.7% vs. 72.5%, $p=0.022$). Conversely, a significantly greater proportion of ARs reported prescribing a maximum daily dose of 80 mg ($p=0.028$).

Regarding pulse MP dosing, PRs predominantly preferred weight-based regimens, most commonly 30 mg/kg/day ($p<0.001$), whereas ARs more frequently used fixed-dose regimens, primarily 1000 mg/day ($p>0.05$) (Table 1). Concerning the maximum duration of pulse MP therapy, a 3-day regimen was significantly more common among ARs ($p=0.026$), while the majority of PRs reported administering pulses for longer durations; however, this difference did not reach statistical significance ($p=0.065$). ANCA-associated vasculitis (AAV) was the most common indication for pulse MP therapy by both groups with no significant difference ($p=0.515$). All PRs and the majority of ARs reported using pulse MP treatment for systemic lupus erythematosus (SLE), and the difference between the groups was statistically significant ($p=0.023$). Besides AAV, PRs tended to use pulse MP more frequently for Still's disease, non-systemic juvenile idiopathic arthritis (JIA)/rheumatoid arthritis (RA), localized scleroderma, systemic sclerosis, juvenile dermatomyositis, Takayasu arteritis, and Kawasaki disease (KD) ($p<0.001$).

Bridging and Tapering Practices of Oral Corticosteroids

Table 2 shows clinicians' strategies for bridging and tapering corticosteroids in JIA and RA. The majority of PRs preferred starting bridging corticosteroid at 1–2 mg/kg/day, whereas ARs preferred using 10–20 mg/day ($p<0.001$). The majority of PRs reported discontinuing

Table 1 Oral corticosteroid and pulse methylprednisolone practices of pediatric and adult rheumatologists

	Pediatric rheumatologists, *n* (%)	Adult rheumatologists, *n* (%)	*p* value
Preferred oral CS preparations			
Prednisolone	53 (88.3)	37 (92.5)	0.374
MP	44 (73.3)	39 (97.5)	0.002*
Deflazacort	7 (11.7)	8 (20)	0.253
Dexamethasone	15 (25)	5 (12.5)	0.126
Others	5 (8.3)	2 (5.0)	0.412
Maximum daily oral CS dose			
80 mg/day	2 (3.3)	7 (17.5)	0.028*
60 mg/day	55 (91.7)	29 (72.5)	0.022*
40 mg/day	3 (5)	4 (10)	0.433
Daily pulse MP dose			
15 mg/kg	14 (23.3)	4 (10)	0.151
20 mg/kg	3 (5.0)	0 (0)	0.273
30 mg/kg	43 (71.6)	0 (0)	0.000*
Maximum daily pulse MP dose			
250 mg	5 (8.3)	0 (0)	0.518
500 mg	8 (13.3)	3 (7.5)	0.518
750 mg	2 (3.3)	0 (0)	0.515
1000 mg	50 (83.3)	37 (92.5)	0.302
Duration of pulse MP treatment			
3 days	17 (28.3)	21 (52.5)	0.026*
5 days	38 (63.3)	17 (42.5)	0.065
7 days	5 (8.3)	2 (5)	0.400
Diseases in which pulse MP is used			
AAV	58 (96.7)	40 (100)	0.515
SLE	60 (100)	36 (90)	0.023*
Still's disease	59 (98.4)	25 (64.1)	0.000*
Non-systemic JIA/RA	8 (14.5)	0 (0)	0.019*
Localized scleroderma	9 (15)	0 (0)	0.010*
Systemic sclerosis	19 (31.1)	3 (7.5)	0.004*
Juvenile dermatomyositis/dermatomyositis	51 (85)	22 (55)	0.001*
MCTD	21 (35)	7 (17.5)	0.056
Takayasu arteritis	52 (85)	13 (33.3)	0.000*
Kawasaki disease	20 (33.3)	0 (0)	0.000*

CS corticosteroid, *MP* methylprednisolone, *AAV* ANCA-associated vasculitis, *SLE* systemic lupus erythematosus, *JIA* juvenile idiopathic arthritis, *RA* rheumatoid arthritis, *MCTD* mixed connective tissue disease

*Statistically significant ($p < 0.05$)

Table 2 Bridging and tapering practices for oral corticosteroids

	Pediatric rheumatologists, *n* (%)	Adult rheumatologists, *n* (%)	*p* value
Bridging oral CS dose			
0.5 mg/kg/day	18 (30)	11 (27)	0.964
1–2 mg/kg/day	40 (66.7)	4 (10)	0.000*
10–20 mg/day	2 (3.3)	25 (62.5)	0.000*
Pattern of bridging oral CS per day			
Divided	39 (65)	31 (77.5)	0.265
Single	21 (35)	9 (22.5)	
Duration of bridging oral CS therapy			
15 days	18 (30)	1 (2.5)	0.000*
30 days	23 (38.3)	2 (5)	0.000*
45–90 days	19 (31.7)	37 (92.5)	0.000*
Maintenance dose of oral CS therapy if not discontinued			
2.5 mg/day	1 (1.7)	8 (20)	0.003*
5 mg/day	24 (40)	18 (45.5)	0.772
10 mg/day	2 (3.3)	0 (0)	0.515
Duration of oral CS therapy if not discontinued			
1 month	3 (5)	1 (2.5)	0.648
3 months	33 (55)	6 (15)	0.000*
4–6 months	4 (6.7)	12 (30.0)	0.003*
12 months	2 (3.3)	14 (35)	0.000*
Based on activation	2 (3.3)	3 (7.5)	0.386
Percentage of oral CS dose reduction at each tapering step			
10%	1 (1.7)	0 (0)	0.600
15%	17 (28.3)	7 (17.5)	0.214
25%	37 (61.7)	24 (60)	0.515
50%	5 (8.3)	9 (22.5)	0.045*
Alternate day regimen during reduction of oral CS	27 (45)	35 (87)	0.000*
Percentage of patients in which alternate day regimen is used			
10–25%	11 (18.3)	8 (20)	1.000
50%	7 (11.7)	4 (10)	1.000
75–100%	11 (18.3)	21 (52.5)	0.000*

CS corticosteroid

*Statistically significant ($p < 0.05$)

bridging therapy within 15–30 days ($p<0.001$), whereas ARs preferred to continue bridging therapy for 45–90 days ($p<0.001$). Although both groups predominantly preferred the smallest maintenance dose of 5 mg/day when continuation was required ($p>0.05$), ARs reported using 2.5 mg/day corticosteroid significantly more often than PRs ($p=0.003$). In cases where continuation of bridging therapy was necessary, the majority of PRs preferred not to exceed 3 months, while 30% of ARs stated an extended treatment up to 4–6 months, and 35% up to 12 months ($p\leq0.001$). The most common oral corticosteroid tapering rate was 25% ($p>0.05$), whereas ARs were significantly more likely to prefer a 50% reduction or an alternate-day regimen ($p<0.05$).

Side Effects

Table 3 compares monitoring practices, side effects, and preventive measures between ARs and PRs during MP pulse therapy. The most commonly reported side effects were hyperglycemia (90%), hypertension (72%), flushing (41%), and arrhythmia (27%). The only statistically significant difference was observed with delirium, which was reported more by ARs ($p=0.003$).

Monitoring Practices

Complete blood count (CBC) (94%), kidney function tests (KFTs) (83%), liver function tests (LFTs) (81%), and acute phase reactants (APRs) (79%) were the most commonly performed laboratory evaluations prior to corticosteroid initiation without any significant differences ($p>0.05$). Peripheral blood smear (PBS) and viral serology evaluations were performed significantly more often by PRs ($p\leq0.001$ and $p=0.034$), whereas hepatitis serology by ARs ($p=0.014$). Compared to ARs, a greater proportion of PRs reported requesting regular ophthalmologic examination ($p<0.001$). PRs recommended follow-up every 6 months ($p<0.05$), whereas most ARs preferred annual examinations ($p>0.05$). Bone mineral density (BMD) for patients on corticosteroid maintenance therapy was performed significantly more often by ARs ($p=0.042$).

Preventive Measures for Corticosteroid Complications

In terms of prophylactic treatments, PRs prescribed concomitant proton pump inhibitor (PPI) and vitamin D significantly more common than ARs ($p<0.05$). Almost all PRs (98.3%) and 87.5% of ARs recommended dietary salt and sugar restriction during systemic corticosteroid therapy ($p<0.05$).

Vaccination Practices

Table 4 summarizes the vaccination practices. Clinicians prioritized the assessment of hepatitis B vaccination status most highly (51%). PRs were significantly more likely to assess meningoccocus, measles–mumps–rubella (MMR), and varicella zoster virus (VZV) vaccination status ($p<0.05$).

Glucocorticoid Toxicity Index

Only 23% of respondents reported using GTI in their clinical practice ($p=0.206$). SLE was the most frequently reported rheumatologic disease for GTI assessment, yet the overall frequency of use remained very limited (25%).

DISCUSSION

This study provides an overview of real-life corticosteroid utilization, tapering, and monitoring strategies among PRs and ARs. To our knowledge, this is the first study to directly compare and evaluate the approaches of two specialties to corticosteroid therapy in rheumatic diseases. The present survey showed heterogeneity in terms of choice of formulation and dose of corticosteroids, preventive measures of adverse effects, and immunization practices between ARs and PRs.

Table 3 Monitoring practices, side effects, and prophylactic measures during systemic corticosteroid therapy among pediatric and adult rheumatologists

	Pediatric rheumatologists, *n* (%)	Adult rheumatologists, *n* (%)	*p* value
Side effects of pulse CS infusion			
Hyperglycemia	52 (86.7)	38 (95)	0.308
Hypertension	45 (75)	27 (67.5)	0.555
Delirium	1 (1.7)	8 (20)	0.003*
Fever	3 (5)	3 (7.5)	0.681
Flushing	21 (35)	20 (50)	0.198
Arrhythmia	17 (28.3)	10 (25)	0.890
Respiratory distress	3 (5)	1 (2.5)	0.648
Chest pain	1 (1.7)	0 (0)	1.000
Posterior reversible encephalopathy syndrome	1 (1.7)	0 (0)	1.000
Baseline evaluations prior to systemic CS therapy			
None	3 (3)	0 (0)	0.273
CBC	56 (93.3)	38 (95)	1.000
PBS	44 (73)	1 (2.5)	0.000*
KFTs	48 (80)	35 (89.7)	0.314
LFTs	47 (78.3)	34 (85)	0.567
Acute-phase reactants	50 (83.3)	28 (72.5)	0.293
Hepatitis serology	30 (33.3)	30 (76.9)	0.014*
Viral serology	20 (33.3)	5 (11.5)	0.034*
Beta-HCG	4 (6.7)	8 (20)	0.090
MRI-confirmed vascular necrosis in patients using systemic CS	58 (96.7)	39 (97.5)	0.649
Anatomic site of MRI-confirmed avascular necrosis observed			
Hip	56 (93.3)	38 (95)	1.000
Knee	10 (16.7)	13 (32.5)	0.109
Ankle	2 (3.3)	4 (10)	0.214
Vertebrates	2 (3.3)	0 (0)	0.515
Bone mineral density assessment for patients on maintenance CS treatment	54 (90)	40 (100)	0.042*
Frequency of bone mineral density assessment			
Every year	47 (78)	33 (82.5)	0.403
Every 2 years	7 (11.7)	7 (17.5)	0596

Table 3 continued

	Pediatric rheumatologists, *n* (%)	Adult rheumatologists, *n* (%)	*p* value
Prophylactic therapy during systemic CS treatment			
PPI	54 (90)	26 (65)	0.005*
Vitamin D	31 (51.7)	11 (27.5)	0.028*
Oral calcium	6 (10)	5 (12.5)	0.751
Regular ophthalmologic examination for patients on maintenance corticosteroid treatment	52 (86.7)	22 (55)	0.0010*
Ophthalmologic examination intervals for patients on maintenance CS treatment			
Every 3 months	8 (15)	1 (4)	0.081
Every 6 months	26 (49)	4 (16)	0.001*
Every year	19 (31.7)	20 (50)	0.052
Salt and sugar restriction during systemic CS therapy	59 (98.3)	35 (87.5)	0.036*

CS corticosteroid, *CBC* complete blood count, *PBS* peripheral blood smear, *KFT* kidney function test, *LFT* liver function test, *Beta-HCG* human chorionic gonadotrophin, *PPI* proton pump inhibitor

*Statistically significant ($p < 0.05$)

There are various forms of therapeutic corticosteroids with varying degrees of glucocorticoid and mineralocorticoid effect, potency, and pharmacodynamic properties [5]. Current international guidelines emphasize using the lowest effective dose for the shortest possible duration and tapering/ceasing once the disease control is achieved [7, 8]. However, they provide no clear recommendations about the most suitable and safest formulation. In our study, prednisolone was the most commonly preferred oral corticosteroid by PRs, with a maximum daily dose of 60 mg, while ARs preferred mostly MP with a maximum dose of 80 mg/day. Prednisolone is usually the choice of oral therapy in both adult and pediatric rheumatology practice [1, 9–12]. Compared to prednisolone, MP is more potent, has less mineralocorticoid activity, and is available in both intravenous and oral formulations; however, it is less suitable for long-term daily regimen because of its higher tissue uptake and half-life that prolong the duration of steroid exposure and increase the risk of growth suppression [5, 13]. Recently deflazacort has gained popularity as a potentially safer alternative for long-term therapy in children owing to its lower risks of growth retardation and adrenal suppression and also in adults for its bone-sparing effect [14]. Nevertheless, only 11.7% of PRs and 20% of ARs in our survey reported using it, probably owing to lack of large-scale studies [3]. Overall, the maximum daily doses of oral corticosteroids preferred by clinicians were in line with current recommendations [3, 7].

Pulse MP therapy rapidly suppresses severe exacerbations while reducing the cumulative toxicity associated with long-term continuous treatment [3]. Several sources support the use of pulse corticosteroid for induction and flare management. The advised dose is usually 15–30 mg/kg/day for pediatric patients and >250 mg/day for adult patients, with a maximum of 1 g/day with treatment durations changing between 1 and 7 days depending on the underlying disease [15–21]. In our survey, the doses preferred by clinicians are consistent with the literature; however, ARs reported significantly shorter pulse courses compared to PRs, likely reflecting the more aggressive and severe course of childhood-onset rheumatic diseases, which often

Table 4 Comparison of vaccination practices among pediatric and adult rheumatologists in relation to systemic corticosteroid therapy

	Pediatric rheumatologists, *n* (%)	Adult rheumatologists, *n* (%)	*p* value
Vaccines evaluated prior to systemic CS therapy			
Hepatitis B	29 (48.3)	22 (55)	0.653
Pneumococcus	19 (31.7)	16 (40)	0.521
Meningoccocus	12 (20)	0 (0)	0.001*
MMR	28 (46.7)	0 (0)	0.000*
Varicella zoster	30 (50)	0 (0)	0.000*
Influenza	8 (13.3)	9 (22.5)	0.356
Covid-19	4 (6.7)	0 (0)	0.151
HPV	3 (5)	0 (0)	0.273
No inquiries about vaccination	23 (38.3)	16 (40)	0.867
Recommended time interval between inactivated vaccination and CS initiation			
1 day	22 (37.9)	11 (27.5)	0.390
1 week	3 (5.2)	8 (20)	0.025*
2 weeks	11 (18.9)	12 (30)	0.265
4 weeks	3 (5.2)	0 (0)	0.273
3–6 months	0 (0)	0 (0)	N/A
No cases encountered	21 (35)	8 (20)	0.163
Recommended time interval between live vaccination and CS initiation			
1 day	1 (1.7)	0 (0)	1.000
1 week	1 (1.7)	2 (5)	0.562
2 weeks	7 (11.7)	8 (20)	0.397
4 weeks	26 (43.3)	15 (37.5)	0.709
3–6 months	5 (8.3)	1 (2.5)	0.397
No cases encountered	20 (33.3)	14 (35)	1.000
Time allowed after inactive vaccination to start CS therapy			
1 day	23 (38.3)	12 (30)	0.521
1 week	5 (8.3)	5 (12.5)	0.515
2 weeks	9 (15)	12 (30)	0.120
4 weeks	10 (16.7)	4(10)	0.518
3–6 months	11 (18.3)	7 (17.5)	1.000

Table 4 continued

	Pediatric rheumatologists, *n* (%)	Adult rheumatologists, *n* (%)	*p* value
No cases encountered	2 (3.3)	0 (0)	0.515
Time allowed after live vaccination to start CS therapy			
1 day	0 (0)	1 (2.5)	0.400
1 week	1 (1.7)	3 (7.5)	0.299
2 weeks	2 (3.3)	6 (15)	0.057
4 weeks	35 (58.3)	16 (40)	0.111
3–6 months	10 (16.7)	0 (0)	0.005
No cases encountered	12 (20)	14 (35)	0.149
GTI utilization	16 (26.7)	7 (17.5)	0.206
Diseases in which GTI was utilized			
SLE	15 (25)	9 (22.5)	0.484
Still's disease	12 (20)	20 (10)	0.145
Non-systemic JIA/RA	2 (3.4)	2 (5)	0.239
Systemic sclerosis	5 (8.3)	0 (0)	0.096
Localized sclerosis	1 (1.7)	0 (0)	0.412
Juvenile dermatomyositis/dermatomyositis	6 (10)	4 (10)	1.000
MCTD	3 (5)	2 (5)	1.000
AAV	9 (15)	8 (20)	0.704
Takayasu arteritis	6 (10)	2 (5)	0.367

CS corticosteroid, *MMR* mumps–measles–rubella, *HPV* human papillomavirus, *GTI* glucocorticoid toxicity index, *SLE* systemic lupus erythematosus, *JIA* juvenile idiopathic arthritis, *RA* rheumatoid arthritis, *MCTD* mixed connective tissue disease, *AAV* ANCA-associated vasculitis

*Statistically significant ($p < 0.05$)

necessitate more intensive corticosteroid treatment [22]. In line with this, higher proportion of PRs in our survey reported using pulse MP in Still's disease, as macrophage activation syndrome (MAS), a life-threatening complication of Still's disease, occurs more frequently in children [19, 23].

In systemic and localized scleroderma, PRs also reported greater pulse MP use. Although not recommended in adult systemic sclerosis cases due to the risk of renal crisis, Furusawa et al. have suggested that pulse MP can be used safely in pediatric cases with close monitoring of blood pressure and renal function tests [24, 25]. Localized scleroderma occurs predominantly in pediatric patients and Childhood Arthritis and Rheumatology Research Alliance (CARRA) consensus guidelines endorse pulse MP in combination with cDMARDs as induction therapy [26]. However anti-RNA polymerase III positivity was shown to increase renal crisis risk exceptionally in some subsets of the disease and thus close observation or complete avoidance of systemic corticosteroid was strictly recommended for these patients [27]. For takayasu arteritis

(TA) both American College of Rheumatology (ACR) and European Alliance of Associations for Rheumatology (EULAR) guidelines discourage pulse therapy stating that high-dose glucocorticoid (40–60 mg/day) is sufficient [15, 21]. Nevertheless, studies indicate that childhood-onset TA present with more severe manifestations and higher risk of mortality which may explain why PRs more often consider pulse therapy [28]. In our survey, 33.3% of PRs reported considering pulse MP in Kawasaki disease whereas ARs reported never using pulse therapy although adult-onset cases have also been described [29]. Notably, in contrast to the SHARE 2018 guideline, the most recent ACR and American Heart Association (AHA) guidelines recommend high-dose corticosteroids rather than pulse therapy in IVIG-resistant or high-risk patients [30–32].

Oral corticosteroids are frequently used as bridging therapy to suppress inflammation rapidly and prevent damage until cDMARDs demonstrate therapeutic effects [33]. PRs reported using bridging corticosteroids at a starting dose of 1–2 mg/kg/day, usually in divided doses for 15–30 days, whereas ARs preferred fixed doses of 10–20 mg/day for longer durations. There is no universally accepted dosing or tapering strategy for bridging therapy. However, long-term glucocorticoid treatment should not be discontinued abruptly because of the risk of adrenal insufficiency [34]. ACR recommends bridging glucocorticoids for initiation or escalation of therapy in moderate-to-highly active polyarticular-JIA and also in enthesitis-related arthritis (ERA) with active sacroiliitis, generally for up to 3 months [35]. ACR highlights potential issues regarding tapering difficulty that may eventually lead to prolonged use of glucocorticoids [4]. For new onset polyarticular-JIA, CARRA allows bridging glucocorticoids at any step using doses of 0.2 mg/kg/day (max 20 mg/day) tapered within 2 weeks, 0.5 mg/kg/day (max 30 mg/day) tapered within 1 month, or 1 mg/kg/day (max 60 mg/day) tapered either within 1 month or slowly over 3 months [36]. For RA, EULAR recommends bridging therapy with a strong emphasis on discontinuation within a maximum of 3 months, though low-dose corticosteroid use is solely allowed for difficult-to-treat RA cases [37]. A survey demonstrated that 15–30 mg/day prednisolone in RA is the most commonly prescribed bridging dose and is typically discontinued within 6 months [38]. In our study, 37.5% of ARs reported continuing oral glucocorticoids in minimal doses, generally ≤ 5 mg/day, mostly for up to 4–6 months, sometimes even 12 months. If discontinuation was not immediately possible, many PRs reported maintaining the dose of 5 mg/day up to 3 months.

In some rheumatic diseases such as AAV and SLE, oral corticosteroids are started as a part of induction therapy at medium-to-high doses, then tapered slowly and continued at low dose for a prolonged time to maintain remission and prevent flares [39]. In JIA-associated severe complications such as MAS, carditis, pleuritis, or peritonitis, glucocorticoids should be tapered to low dose within 3 months after pulse therapy and discontinued within the following 3 months [19]. Despite discontinuation is encouraged, prolonged corticosteroid use remains common. A meta-analysis demonstrated that patients with both RA and SLE achieved low disease activity with continuous low-dose glucocorticoid treatment and tapering caused disease flares more often [40]. To guide clinicians through tapering and discontinuing corticosteroids, Priya et. al. designed a three-step tapering algorithm for medium–high dose oral corticosteroids. Dose is reduced by 25%/week and 12.5%/week during rapid and gradual tapering phases respectively. In slow tapering phase where near-physiological dose of corticosteroid is achieved (5 mg/day), alternate day treatment is recommended [41]. Ravelli et al. recommended reducing moderate-to-high doses of glucocorticoids by 5–10 mg at a time, whereas lower doses should be reduced in even smaller proportions and alternate day regimen must be considered whenever feasible [3]. Consistent with the recommendations, both PRs and ARs most commonly preferred reducing oral corticosteroid dose by 25% at each tapering step; however, ARs were more likely to employ larger dose reductions and alternate day regimens.

The most common adverse effects of pulse MP include hyperglycemia and infections whereas the most severe ones comprise hypertension, seizures, arrhythmia, and neuropsychiatric symptoms [42]. In our survey, the most frequently

reported complications were hyperglycemia, hypertension, flushing, and arrhythmia, respectively. Similar to a retrospective study showing that delirium was the most common corticosteroid-induced psychiatric manifestation, ARs in our survey reported observing delirium significantly more often than PRs [43]. This may reflect the increased susceptibility to neuropsychiatric disorders and higher risk of comorbidities with advanced age [44]. In line with previous studies, almost all clinicians reported observing MRI-confirmed avascular necrosis, particularly of the hip [1].

Prior to initiating medium-to-high dose corticosteroids, EULAR recommends evaluating for comorbidities that may increase treatment-related complications [8]. Screening for symptoms of serious infections is essential because corticosteroids may exacerbate underlying infections. Owing to underlying immune dysregulation, patients with rheumatic diseases are at increased risk of opportunistic infections including *Pneumocystis jirovecii*, tuberculosis, hepatitis B/C, and herpes zoster viruses [45]. In our survey, ARs were significantly more likely to request hepatitis serology given that routine hepatitis B vaccination has been implemented in children since 1998 in Türkiye and older populations have higher risk of hepatitis B infection [46]. On the other hand PRs reported requesting other viral serology tests and PBS more often probably reflecting a more comprehensive approach to differential diagnosis [47].

For children expected to require long-term treatment, assessment of nutrition, development, and immunization status is essential [36]. Numerous studies showed that > 5 mg/day prednisolone for 3–6 months results in significant decline in BMD and increase in fracture risk [1]. Therefore, annual BMD assessment is advised to assess bone health; however, ACR recommends first BMD evaluation within 6 months after the initiation of corticosteroids in children [1]. In our study, consistent with recommendations, both PRs and ARs reported ordering BMD annually. Cataract and glaucoma typically occur in patients using prednisolone more than 10 mg/day for at least a year and annual ophthalmologic examinations are recommended for these individuals. Immature lenses are more prone to effects of steroids and more frequent ophthalmologic examinations are needed in children [48]. These findings may explain why PRs in our survey preferred shorter intervals between ophthalmologic examinations.

Glucocorticoids disturb intestinal absorption and renal tubular reabsorption of calcium leading to bone loss. Although prevention and management of osteoporosis are well defined for adults, there are no established guidelines for children [1]. Given that both inflammation and glucocorticoids contribute to impaired bone metabolism and that vitamin D monotherapy is not as efficient as combination therapy, pediatric patients using > 7.5 mg/day for more than 3 months are advised to use 1000–2000 mg/day calcium together with 600 IU/day vitamin D [7, 8, 36]. In our survey, PRs are more likely to initiate vitamin D prophylaxis alone, whereas combination of calcium and vitamin D is more often preferred by ARs, likely reflecting the higher risk of osteoporosis and fracture in the adult population.

In our survey, PRs stated to investigate patients for VZV, MMR, and meningococcal vaccinations significantly more than ARs. EULAR recommends non-live seasonal influenza vaccination, MMR booster, and VZV for patients receiving low-dose glucocorticoids. Most clinicians reported waiting 1 day after an inactivated vaccination and 4 weeks after a live vaccination ($p > 0.05$). Similarly, most clinicians reported postponing inactivated and live vaccination for 1 day and 4 weeks, respectively, after the completion of therapy ($p > 0.05$). Non-live vaccines can be administered any time during immunosuppressive therapy, whereas live-attenuated vaccines should be avoided during corticosteroid treatment. The optimum time for live vaccines is 4 weeks before the immunosuppressive treatment to provide sufficient time for antibody responses or 4 weeks after the initiation of treatment to allow immune system to regain immune competency [49, 50]. Interestingly, a high percentage of clinicians reported not inquiring about vaccination status prior to initiating therapy. This finding likely reflects acute clinical scenarios where the immediate benefits of life-saving corticosteroid

therapy heavily surpass the potential risks of delayed treatment [50].

Our survey demonstrated that GTI is rarely utilized by both PRs and ARs; however, greater integration of this tool into clinical practice will support individualized toxicity assessment and earlier transition to steroid-sparing therapies.

The study has several limitations. Firstly, this is a single-country, cross-sectional survey study conducted among rheumatologists in Türkiye. The findings reflect national practice patterns and may not be generalizable to other countries. For instance, prodrug prednisone is not available in Türkiye; however, in North America it is the preferred choice unless the patient has severe hepatic impairment [1, 11]. Secondly the study was based on self-reported practices rather than actual prescribing data which may be subject to recall and reporting bias.

CONCLUSION

This is the first study evaluating and comparing approaches of PRs and ARs to systemic corticosteroids in their routine clinical practice. Overall, our findings demonstrated significant differences between the two groups regarding formulation preferences, dosing and tapering strategies, pulse, bridging and maintenance practices, preventive measures as well as monitoring complications and vaccination assessments. Although these variations among clinicians partly reflect differences in patient populations, comorbidity profiles, and disease presentations, this study also highlights the inconsistencies within current international guidelines and the need for uniform, evidence-based, and age-specific recommendations. Despite the development of biologic agents targeting more specific pathways, systemic corticosteroids are still fundamental in our clinical practice and will not be replaced in the near future. Therefore, collaborative efforts involving both pediatric and adult specialists are critical to improve corticosteroid practices and optimize safety across the field.

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Declarations

Conflict of Interest. Övgü Özenli Yağcı has nothing to disclose. Çisem Yıldız has nothing to disclose. Deniz Gezgin Yıldırım has nothing to disclose. Emre Bilgin: has nothing to disclose. Emre Bilgin is an Editorial Board member of

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