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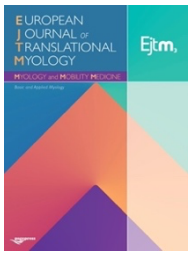

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Risk factors and critical thresholds for glucocorticoid-induced ocular adverse reactions in children: implications for muscle and neuromuscular disease management

You Li,[1*] Tingxin Cui,[1*] Zhilang Lin,[2*] Lanqin Zhao,[1] Yunxi Lai,[1] Dongyuan Yun,[1] Zikai Lin,[1] Mingyuan Li,[1] Yunjian Huang,[1] Shiyuan Chen,[1] Dongni Wang,[1] Yuanquan Qiu,[2] Yuanyuan Xu,[2] Yahan Yang,[1] Duoru Lin,[1] Xiaoyun Jiang,[2] Haotian Lin[1,3,4]

[1]Zhongshan Ophthalmic Center, Sun Yat-sen University, WHO Collaborating Centre for Eye Care and Vision, State Key Laboratory of Ophthalmology, Guangdong Provincial Key Laboratory of Ophthalmology and Visual Science, Guangdong Provincial Clinical Research Center for Ocular Diseases, Guangzhou; [2]Department of Pediatric Nephrology and Rheumatology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou, Guangdong; [3]Hainan Eye Hospital and Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Haikou; [4]Department of Genetics and Biomedical Informatics, Zhongshan School of Medicine, Institute for Frontier Interdisciplinary Research in Health Sciences and Technology, Sun Yat-sen University, Guangzhou, China

[*]These authors contributed equally

Abstract

Systemic Glucocorticoid (GC) therapy is integral to managing various paediatric conditions, including inflammatory muscle and neuromuscular diseases. However, prolonged GC use in children poses a significant risk for severe ocular Adverse Drug Reactions (ADRs), notably Posterior Subcapsular Cataract (PSCC) and Steroid-Induced Ocular Hypertension (SIOH). These ADRs can lead to irreversible visual impairment, creating a substantial burden, particularly for paediatric patients already managing chronic conditions. Identifying specific risk factors and precise exposure thresholds is crucial for optimizing GC treatment and guiding timely ophthalmic monitoring. This retrospective case–control study analyzed data from 305 children with kidney disease, who received oral or intravenous GCs between December 2020 and December 2022. Participants were grouped into PSCC, SIOH, or control (no ocular ADRs). Logistic regression assessed risk factors, and Receiver Operating Characteristic (ROC) analysis determined critical thresholds for cumulative dose and duration. Results indicated seven significant risk factors for PSCC:

younger age, longer GC duration, hypertension, growth retardation, vitamin D deficiency, immunosuppressant use, and oral methylprednisolone. Critical thresholds for cataract onset were identified as GC treatment duration >5.6 months or a cumulative dose >5,888 mg. For SIOH, higher daily GC dosage (>0.59 mg/kg/day), oral methylprednisolone, and growth retardation were significant risk factors. These findings elucidate key risk factors and establish quantitative GC exposure thresholds for ocular ADRs in children. They provide evidence-based guidance for ophthalmic screening and intervention timing, particularly relevant for paediatric patients with muscle and neuromuscular diseases requiring long-term GC therapy. Proactive monitoring and tailored GC management are essential to mitigate vision-threatening complications and improve long-term patient outcomes.

Key words: glucocorticoid; posterior subcapsular cataract; steroid-induced ocular hypertension; children; ocular adverse drug reactions; muscle disease; neuromuscular disease; paediatric ophthalmology.

Introduction

Glucocorticoids (GCs) are widely used to treat various pediatric diseases, including nephrotic syndrome, systemic lupus erythematosus, and anaphylactic purpura.[1-3] Despite their therapeutic benefits, prolonged or high-dose GC use is linked to a range of systemic and ocular Adverse Drug Reactions (ADRs), such as growth retardation, infections, osteoporosis, Posterior Subcapsular Cataract (PSCC), Steroid-Induced Ocular Hypertension (SIOH), and steroid-induced glaucoma.[4] As children are at a critical stage of visual development, these ocular ADRs can severely impact their long-term quality of life.[5] Previous studies report PSCC incidence rates of 10.3% to 33.3% in children following GC treatment, which may impair early visual development.[6-8] Similarly, SIOH has been reported in 9.1% to 71.0% of pediatric GC users, with some cases progressing to glaucoma—a vision-threatening optic neuropathy that can cause permanent visual impairment.[9-13] Although children face a higher risk of GC-related ocular ADRs,[12,14] characterized by earlier onset, faster progression, and greater severity, the proportion receiving regular ophthalmic screening remains low.[10,15] Therefore, identifying reliable risk factors and establishing evidence-based screening protocols for high-risk pediatric populations are therefore urgent clinical priorities.

Previous studies on risk factors for GC-associated ocular ADRs have focused largely on local administration—particularly topical eye drops—and have been conducted mainly in adults.[9,16-25] Consequently, these findings may not be directly applicable to children receiving systemic therapy. Pediatric-specific studies on systemic GC-related ocular complications remain scarce and are often limited by small sample sizes, typically under 100 participants.[9,26] Although some reports present median or average GC dose and duration in children who developed ocular ADRs,[6,8,12] current clinical guidance lacks evidence to answer a fundamental question: at what cumulative dose or after what treatment duration do these sight-threatening complications typically occur in children?

To address these evidence gaps, we conducted a clinical study with the following aims: first, to investigate risk factors for the development of PSCC and SIOH in children on long-term systemic GC therapy; and second, to explore potential thresholds of cumulative dose and treatment duration associated with these ocular ADRs. Our findings are intended to support early identification of high-risk children, inform screening schedules, promote safer GC prescribing, and guide timely ophthalmological intervention to prevent irreversible visual loss.

Materials and Methods

Study design, setting, and participants

This retrospective case–control study was conducted at the Pediatrics Department of the First Affiliated Hospital of Sun Yat-sen University. Eligible participants were children aged 4–18 years, admitted for the first time between December 2020 and December 2022, and currently receiving oral and/or intravenous GCs. Patients were excluded if they had: i) a history of ocular trauma, intraocular surgery, congenital cataracts, infantile glaucoma, or other ocular diseases; ii) received local GC administration (e.g., topical eye drops, ointments, or local infiltration injections); iii) incomplete Electronic Health Records (EHR). Diagnoses of included participants are detailed in online supplementary table 1. Based on ophthalmological diagnosis, 95 children diagnosed with "monocular or binocular drug-induced cataract" were assigned to the PSCC group, and 92 children diagnosed with "monocular or binocular high intraocular pressure" (IOP) or "monocular or binocular steroid-induced glaucoma" were classified into the SIOH group. Additionally, 150 children without ocular ADRs , admitted during the same period, served as controls (Figure 1).

GC therapy followed standard clinical guidelines.[1-3] Oral methylprednisolone was substituted for oral prednisone in cases of abnormal liver function or if methylprednisolone had been used prior to admission.

Intravenous methylprednisolone was administered when high-dose GC therapy was clinically indicated or in the presence of gastrointestinal absorption disorders (e.g., fasting, repeated vomiting, or severe edema).

Definitions of ocular outcomes

PSCC was defined as protein- degenerative opacification beneath the posterior lens capsule. SIOH was defined as GC-induced IOP >21 mmHg, calculated as the mean of three consecutive measurements. SIG was defined according to the Childhood Glaucoma Research Network (CGRN) definition and attributed to GC use.[28] All diagnoses were confirmed by licensed ophthalmologists following clinical consultation.

Data collection

Data were extracted retrospectively from electronic medical records, including demographic characteristics, primary diagnosis, medical history, details of GC therapy (type, route, category, cumulative duration and dose, daily dosage, and medication adherence), ophthalmological examination findings, physical examination measures, and laboratory test results.(the definitions was detailed in online supplementary Table 2 and Table 3).

GC-related systemic ADRs were categorized into 10 domains (online supplementary table 4): growth and development abnormalities, diabetes, hypertension, dyslipidemia, infection, skin changes, musculoskeletal system development abnormalities, gastrointestinal system abnormalities, endocrine system abnormalities, and central nervous system abnormalities. [4]

Statistical analysis

Analyses were performed using SPSS software (version 22.0). Categorical variables are reported as frequencies and percentages. Normally distributed continuous variables are presented as mean ± Standard Deviation (SD); non-normally distributed continuous variables (including the duration of GC use, visual acuity and best-corrected visual acuity) were natural logarithm transformed before analysis and reported as mean ± SD. Other variables (including aspartate aminotransferase, 24-hour urine protein quantification and hematuria) were analyzed as categorical variables following classification.

Univariate logistic regression analysis was performed to calculate the Odds Ratios (ORs) for variables associated with PSCC or SIOH versus controls. Statistically significant ($P<0.05$) and clinically relevant variables were entered into multivariate logistic regression models to identify independent risk factors.

Optimal thresholds for cumulative GC duration and dose were determined using Receiver Operating Characteristic (ROC) curve analysis based on the Youden index. Subgroup analyses were performed for the SIOH and nephrotic syndrome groups after adjusting for confounding variables. A two-tailed $P < 0.05$ was considered statistically significant.

Results

Baseline characteristics

A total of 305 children (337 cases and 674 eyes) were included in this study. The median age was 8 years, and 53.8% were male. Among the participants, 63 children (20.6%) had PSCC, 60 (19.7%) had SIOH or glaucoma, and 32 (10.5%) separately had PSCC and SIOH at different time points and were included as 64 cases. Baseline characteristics are summarized in table 1. The primary diagnoses included nephrotic syndrome, systemic lupus erythematosus, anaphylactoid purpura, IgA nephropathy and other conditions. Disease distribution did not differ significantly among the PSCC, SIOH, and control groups (online supplementary table 5).

Risk factors for the development of PSCC

Univariate logistic regression was performed comparing 95 children with PSCC and 150 controls (Online supplementary table 6). Eight variables showed significant association with PSCC: use of immunosuppressants, use of multiple GC types, use of oral methylprednisolone, presence of systemic GC complications (growth retardation, hypertension, and vitamin D deficiency), longer GC treatment duration, shorter height, higher systolic blood pressure, and elevated triglyceride levels (Table 2). For 92 patients (31 with PSCC, 61 controls) with available cumulative dose data, univariate analysis confirmed that higher cumulative GC dose was significantly associated with PSCC (OR, 1.20; 95% CI, 1.04 to 1.38; P=0.01). Thirteen variables with $P<0.2$ in univariate analysis were entered into multivariate logistic regression. After backward selection, seven factors remained independently associated with PSCC (Figure 2a; Online supplementary table 7): younger age (OR, 0.87; 95% CI, 0.78 to 0.97; P=0.01), longer GC use duration (OR, 3.71 ;95% CI, 1.86 to 7.41; $P<0.001$), hypertension (OR, 2.32; 95% CI, 1.18 to 4.56; P=0.02), growth retardation (OR, 2.08; 95% CI, 1.09 to 3.95; P=0.03), vitamin D deficiency (OR, 2.08; 95% CI, 1.05 to 4.14; P=0.04), use of immunosuppressants (OR, 4.01; 95% CI, 1.78 to 9.02; $P<0.001$) and use of oral methylprednisolone (OR, 3.30; 95% CI, 1.68 to 6.47; $P<0.001$).

The optimal cutoff values for the cumulative duration and dose of GC use were determined using ROC curve analysis with Youden's index. The area under the ROC curve (AUC) for the cumulative GC duration was 0.78 (95% CI, 0.69 to 0.87; P<0.001) (Figure 3a). When the Youden's index reached its maximum value, the sensitivity and specificity were 90.4% and 36.6%, respectively, corresponding to a cutoff of cumulative GC duration of 5.6 months. The cutoff value was assessed using univariate logistic regression analysis, revealing a significantly increased risk of PSCC in children using GCs for more than 5.6 months compared with those with shorter usage (OR 4.45; 95% CI, 1.88 to 10.52; P<0.001). The AUC for the cumulative GC dose was 0.81 (95% CI, 0.72 to 0.90; P<0.001) (Figure 3a). When the Youden's index reached its maximum value, the sensitivity and specificity were 74.2% and 68.3%, respectively, with a cutoff of cumulative GC dose of 5888 mg. The cutoff value was evaluated using univariate logistic regression analysis, revealing a significantly increased risk of PSCC in children with a cumulative GC dose exceeding 5888 mg compared with those with lower doses (OR, 6.36; 95% CI, 2.41 to 16.76; P<0.001).

The diagnostic performance of the cumulative duration and dose of GC use and their two distinct cutoff values was validated using an independent validation cohort comprising 218 subjects (76 with PSCC and 142 without PSCC).

The AUC for the cumulative GC duration was 0.73 (95% CI, 0.67 to 0.80; P<0.001) (Figure 3b), and children exposed to GCs for more than 5.6 months demonstrated a significantly elevated risk of PSCC compared to those with shorter exposure durations (OR, 3.65; 95% CI, 2.01 to 6.61; P<0.001). The AUC for cumulative GC doses was 0.77 (95% CI, 0.70 to 0.83; P<0.001) (Figure 3b), and children receiving a cumulative GC dose exceeding 5,888 mg exhibited a significantly higher risk of PSCC compared to those with lower cumulative doses (OR, 5.34; 95% CI, 2.92 to 9.77; P<0.001). In summary, these findings demonstrate that prolonged GC use (>5.6 months) and high cumulative GC doses (>5,888 mg) are strongly associated with an increased risk of developing PSCC in children, suggesting these thresholds may serve as clinically relevant markers for early identification of at-risk patients.

Risk factors for the development of SIOH

Univariate analysis of 92 children with SIOH and 150 controls (online supplementary table 8) identified 12 variables significantly associated with SIOH, including younger age, use of oral or intravenous methylprednisolone, high-dose GC use, systemic GC complications (growth and development disorders), lower height and weight, elevated total cholesterol, triglycerides, high-density lipoprotein, low-density

lipoprotein, and reduced albumin (Table 3).

Multivariate analysis (including sex, age, and 13 variables with P<0.2 from univariate analysis) with backward selection identified three independent risk factors for SIOH (Figure 2b; Online supplementary table 9): higher daily GC dosage (OR, 7.24; 95% CI, 3.74 to 14.05; P<0.001), use of oral methylprednisolone (OR, 3.60; 95% CI, 1.56 to 8.27; P=0.003), and growth retardation (OR, 3.17; 95% CI, 1.67 to 6.05; P<0.001).

The optimal cutoff value of the daily GC dose per kilogram was determined using ROC curve analysis with Youden's index. The AUC for the daily GC dose per kilogram was 0.78 (95% CI, 0.72 to 0.84; P<0.001; Figure 3c). When the Youden's index reached its maximum value, the sensitivity and specificity were 85.2% and 65.9% respectively, corresponding to a cutoff of GC dose per kilogram per day being 0.59 mg. The cutoff value was assessed using univariate logistic regression analysis, revealing a significantly increased risk of SIOH in children with a GC dose exceeding 0.59 mg/kg*d compared with those with lower doses (OR: 12.42; 95% CI: 5.74 to 26.87; P<0.001).

The diagnostic performance of daily GC dose and its cutoff values was validated using an independent validation set (n=246, 61 with SIOH and 185 without SIOH).

The AUC for the GC dose per kilogram was 0.90 (95% CI, 0.86 to 0.94; P<0.001) (Figure 3d), and univariate logistic regression analysis revealing a significantly increased risk of SIOH in children with a GC dose exceeding 0.59 mg/kg*d compared with those with lower doses (OR: 17.50; 95% CI: 8.43 to 36.34; P<0.001).

Subgroup analysis was performed for GC type, route, and dose after adjusting for confounders (Online supplementary table 10). When restricted to oral administration, methylprednisolone was associated with a higher SIOH risk than prednisolone (OR, 2.84; 95% CI, 1.37 to 5.90; P=0.01). No significant difference was observed between oral and intravenous methylprednisolone when the GC type was the same. When both type and route were controlled, conventional-dose and high-dose intravenous methylprednisolone GC therapy showed no significant difference in effect on IOP.

Discussion

In this retrospective case-control study of 305 children undergoing long-term systemic GC therapy, we identified seven risk factors for PSCC and three for SIOH. Clinically relevant exposure thresholds were established: a cumulative GC duration exceeding 5.6 months or a cumulative dose >5,888 mg was associated

with increased PSCC risk, while a daily GC dose exceeding 0.59 mg/kg was a significant risk factor for SIOH.

Our findings highlight both treatment-related and systemic determinants of ocular toxicity. Oral methylprednisolone use emerged as a consistent risk factor for both PSCC and SIOH, whereas oral prednisolone appeared safer without compromising therapeutic efficacy for underlying conditions. Systemic GC-related complications including hypertension, growth retardation, and vitamin D deficiency were significantly associated with PSCC, while growth retardation was also linked to SIOH. This suggests that children experiencing systemic GC-related ADRs constitute a high-risk subgroup for ocular involvement, warranting earlier and more vigilant ophthalmic surveillance along with careful consideration of GC type and dosage.

This study extends prior literature by including a heterogeneous pediatric population with varied underlying diagnoses and represents the first investigation of GC-related ocular ADRs in a Chinese pediatric cohort, thereby enhancing the generalizability of findings across diverse populations. [10,11,26] Unlike earlier studies limited to small samples or focused on topical GC use in adults, we provide clinically actionable GC exposure thresholds directly relevant to pediatric practice. [20-25]

Although cumulative GC duration and dose have previously been associated with PSCC risk, reported median or mean values vary considerably, reflecting substantial interindividual susceptibility.[6,8,9] Our analysis not only confirms these factors as independent risks but also quantifies specific thresholds, demonstrating that exceeding 5.6 months or 5,888 mg significantly elevates PSCC risk. These thresholds offer a practical tool for identifying high-risk children, facilitating earlier detection and intervention to preserve vision and quality of life. Future studies integrating genomic data may further enable personalized risk stratification.

In contrast to PSCC, previous studies on SIOH have yielded inconsistent results regarding cumulative GC dose. [6,8,9] Given the rapid pharmacokinetics and transient IOP effects of GCs, we focused on daily dosage and identified >0.59 mg/kg/day as a threshold for elevated SIOH risk. This suggests that high-dose GC therapy, even transiently, can precipitate ocular hypertension, emphasizing the need for intensified IOP monitoring during such periods. Early detection and management of SIOH are critical to prevent progression to SIG and irreversible vision loss, thereby improving long-term outcomes and alleviating familial and socioeconomic burdens.

The variability in onset time of PSCC (6 months to 4 years)[6,9,30] and SIOH (5 days to 6 months)[11,29] following GC initiation underscores the limitation of screening based solely on treatment duration. Relying on fixed

time points may delay necessary intervention in high-risk, pre-symptomatic children. The exposure thresholds established in this study offer an evidence-based approach to guide ophthalmology referral and intensify monitoring for children exceeding these limits, potentially reducing missed or delayed diagnoses of sight-threatening ADRs.

Limitations

This study has several limitations. First, all participants were recruited from a single pediatric department, and exclusion of children with incomplete data may introduce selection bias. Multicenter prospective studies are needed to validate these findings. Second, the retrospective design carries a risk of recall bias, though most data were derived from objective device measurements, minimizing observation bias. Third, IOP measurements were obtained during routine clinical visits without time-standardization. While one previous study controlled IOP measurements between 10 AM and 2 PM[13] for diurnal variation, the random timing in our study likely affected all groups equally, limiting its impact on comparative risk estimates.

Conclusions

This study identified multiple risk factors and established quantitative exposure thresholds for PSCC and SIOH in children on long-term systemic GC therapy. The findings support more tailored GC prescribing, risk-stratified ophthalmological screening, and timely intervention to mitigate visual morbidity. These results provide a foundation for future prospective research and contribute to evidence-based strategies aimed at preserving vision in this vulnerable population.

List of Abbreviations

GCs, Glucocorticoids

ADRs, Adverse Drug Reactions

PSCC, Posterior Subcapsular Cataract

SIOH, Steroid-induced Ocular Hypertension

ROC, Receiver Operating Characteristic

AUC, Area Under the ROC curve

HER, electronic health records

IOP, intraocular pressure

CGRN, Childhood Glaucoma Research Network

SD, Standard Deviation

ORs, Odds Ratios

Corresponding Author

Prof. Haotian Lin, Zhongshan Ophthalmic Centre, Sun Yat-sen University, #7 Jinsui Road, Guangzhou, China, 510623.

E-mail: linht5@mail.sysu.edu.cn

ORCID ID NUMBER: 0000-0003-4672-9721

You Li, lyou2018@163.com, 0000-0002-4219-3512

Tingxin Cui, cuitx3@mail2.sysu.edu.cn, 0009-0004-9078-1695

Zhilang Lin, linzhlang@mail.sysu.edu.cn, 0000-0003-2279-9776

Lanqin Zhao, zhaolq7@mail.sysu.edu.cn, 0000-0002-5182-3678

Yunxi Lai, laiyx29@mail2.sysu.edu.cn, 0000-0002-5709-2351

Dongyuan Yun, soniadyyun@outlook.com, 0009-0004-2924-2297

Zikai Lin, linzikai@gzzoc.com, 0000-0003-4672-9721

Mingyuan Li, limingyuan0430@163.com, 0009-0006-4394-7132

Yunjian Huang, 354177363@qq.com, 0009-0001-6674-3523

Shiyuan Chen, 153073734@qq.com, 0009-0007-8612-6032

Dongni Wang, wdn_zoc@foxmail.com, 0000-0002-0960-9598

Yuanquan Qiu, qiuyq35@mail.sysu.edu.cn, 0009-0008-5998-7379

Yuanyuan Xu, xuyy68@mail.sysu.edu.cn, 0000-0003-1883-4567

Yahan Yang, 1007052379@qq.com, 0009-0008-6098-3244

Duoru Lin, lindr5@mail.sysu.edu.cn, 0000-0002-7214-1801

Xiaoyun Jiang, jxiaoy@mail.sysu.edu.cn, 0000-0003-4044-2500

Contributions

Haotian Lin, Xiaoyun Jiang, You Li, Tingxin Cui and Zhilang Lin contributed to the conceptualization of the study; You Li, Dongyuan Yun, Lanqin Zhao, and Mingyuan Li contributed to the methodology of the study; You Li, Yunjian Huang, Shiyuan Chen, Dongni Wang, Yuanquan Qiu collected data; You Li, Lanqin Zhao, Dongyuan Yun and Zikai Lin performed the analyses; You Li, Tingxin Cui and Yunxi Lai contributed to the original draft preparation; and Yahan Yang, Duoru Lin, Xiaoyun Jiang and Haotian Lin contributed to the review and editing of the manuscript. All authors discussed the results, commented on the manuscript, and approved the final manuscript for publication.

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Data Availability

A deidentified analytic dataset on reasonable request will be made available from 1 year after the date of publication of this article. Ethics approval for scientific aims from the investigator's institution should be provided. Requests for data will be reviewed by principal investigators from all participating centers and should be directed to the corresponding author (linht5@mail.sysu.edu.cn).

Conflict of Interest

The authors declare no competing interests.

Ethical Approval

This study involves human participants and was approved by the Ethics Committee of Zhongshan Ophthalmic Center (approval number: 2023KYPJ293) and IEC for Clinical Research and Animal Trials of the First Affiliated Hospital of Sun Yat-sen University (approval number: 2023-719).

Patient and Public Involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this

research.

Patient consent for publication

Written consents were waived in view of the retrospective nature of the study and exclusive use of anonymized data.

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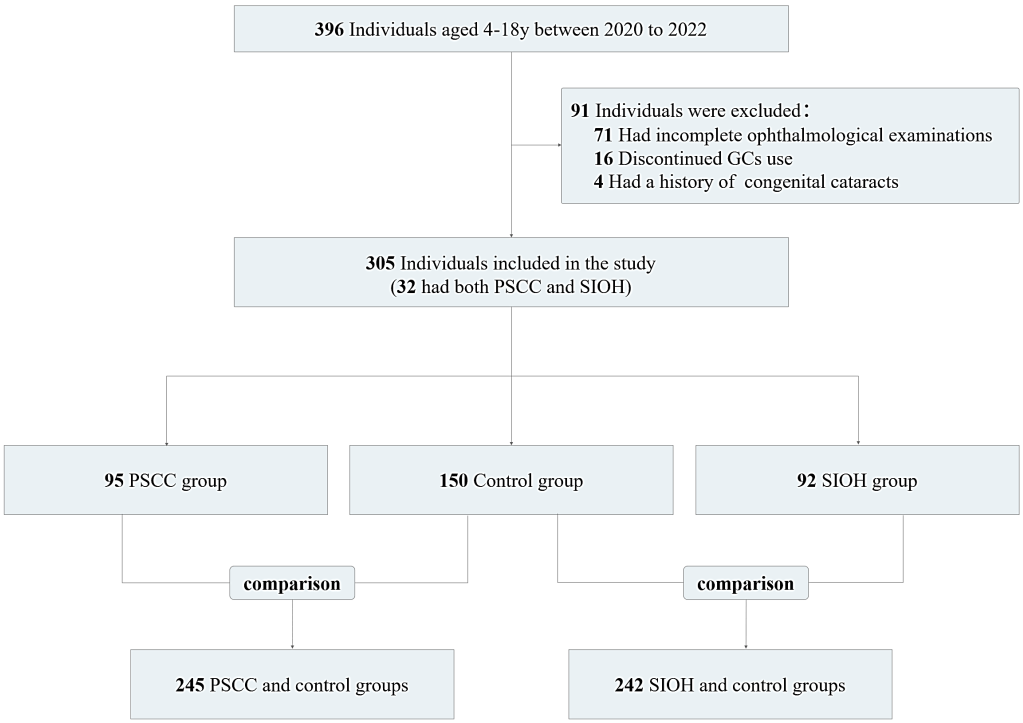
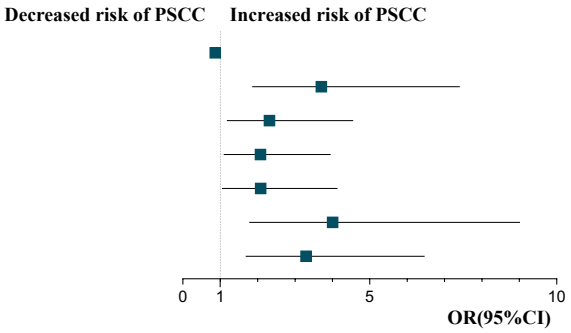


Figure 1. Participant Flow Diagram. During the follow-up period, 32 individuals were diagnosed with PSCC and SIOH at different time points; thus, their records were accordingly classified into the PSCC and SIOH groups, respectively. 150 individuals without ocular adverse drug reactions admitted during the same period were included as the control group.

Abbreviations: GCs, glucocorticoids; PSCC, posterior subcapsular cataract; SIOH, steroid-induced ocular hypertension.

a

Risk Factors	OR(95%CI)	P value
Age	0.87(0.78-0.97)	0.01
Cumulative duration	3.71(1.86-7.41)	<0.001
Hypertension	2.32(1.18-4.56)	0.02
Growth retardation	2.08(1.09-3.95)	0.03
Vitamin D deficiency	2.08(1.05-4.14)	0.04
Immunosuppressant use	4.01(1.78-9.02)	<0.001
Oral methylprednisolone	3.30(1.68-6.47)	<0.001



b

Risk Factors	OR(95%CI)	P value
Daily dose of glucocorticoid	7.24(3.74-14.05)	<0.001
Oral methylprednisolone	3.60(1.56-8.27)	0.003
Growth retardation	3.17(1.67-6.05)	<0.001

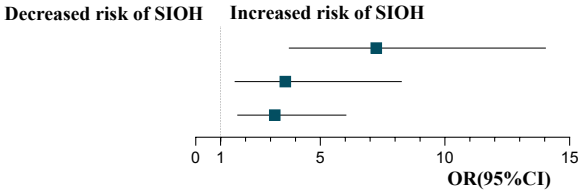


Figure 2. Multivariable Logistic Regression Analysis of Risk Factors for the GC-Related Ocular Adverse Drug Reaction. a, risk factors for the development of PSCC; b, risk factors for the development of SIOH. Error bars show 95% CIs.

Abbreviations: OR, odds ratio; PSCC, posterior subcapsular cataract; SIOH, steroid-induced ocular hypertension.

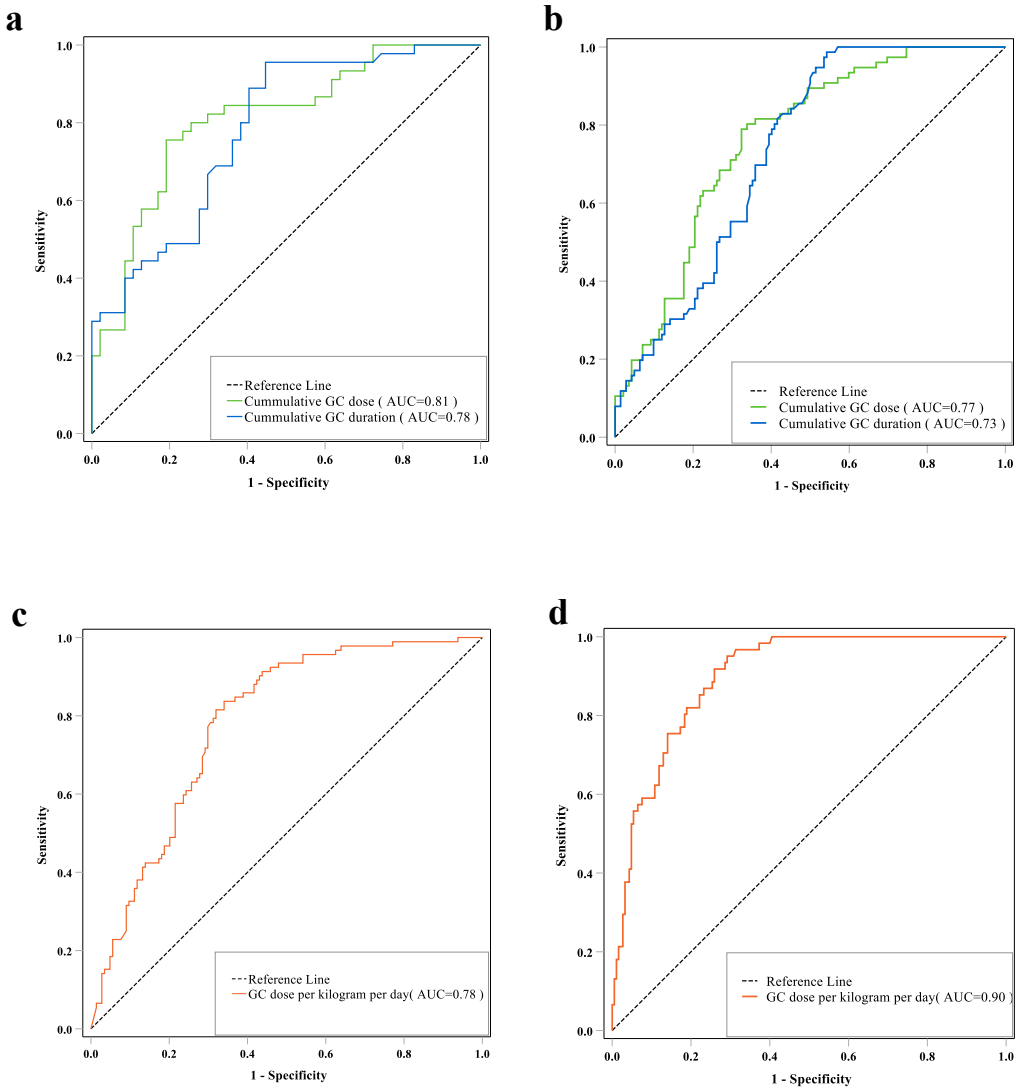


Figure 3. Performance of risk factors in the prediction of PSCC and SIOH. a–b, ROCs for the prediction of PSCC. The AUC for the cumulative GC duration was 0.78 (95% CI, 0.69 to 0.87; P<0.001) in the training set (a) and 0.73 (95% CI, 0.67 to 0.80; P<0.001) in the validation set (b), and the AUC for the cumulative GC dose was 0.81 (95% CI, 0.72 to 0.90; P<0.001) in the training set (a) and 0.77 (95% CI, 0.70 to 0.83; P<0.001) in the validation set (b). **c–d, ROCs for the prediction of SIOH.** The AUC for the daily GC dose per kilogram was 0.78 (95% CI, 0.72 to 0.84; P<0.001) in the training set (c) and 0.90 (95% CI, 0.86 to 0.94; P<0.001) in the validation set (d).

Abbreviations: AUC, area under the ROC curve; GCs, glucocorticoids; PSCC, posterior subcapsular cataract; SIOH, steroid-induced ocular hypertension.

Table 1. Baseline characteristics of study population.

Variable	All participants (n=305）
Age of onset, years, mean±SD	8.0±4.0
Sex, *n*(%)	
Male	164(53.8)
Female	141(46.2)
GC-related ocular ADRs	
None	150(49.2)
PSCC	63(20.6)
SIOH and glaucoma	60(19.7)
PSCC and SIOH	32(10.5)
LogMAR_VA_OD/OS	0.21±0.28 / 0.19±0.25
LogMAR_BCVA_OD/OS	0.02±0.22 / 0.02±0.21
NCT_OD/OS, mmHg	19.7±4.7 / 19.7±4.8

ADR adverse drug reaction, *GC* glucocorticoid, *PSCC* posterior subcapsular cataract, *SIOH* steroid-induced ocular hypertension, *VA* visual acuity, *BCVA* best-corrected visual acuity, *NCT* non-contact tonometer.

Table 2. Risk factors for the development of posterior subcapsular cataract.

Variable	PSCC (n=95)	Controls (n=150)	OR (95% CI)	*P* value
Age at present, years, mean±SD	10.0±3.0	10.0±3.6	0.98 (0.91-1.06)	0.64
Sex, *n*(%)				
Male	49(51.6)	84(56.0)	1[Reference]	/
Female	46(48.4)	66(44.0)	1.20(0.71-2.00)	0.50
Immunomodulator	82(86.3)	85(56.7)	4.82(2.47-9.41)	<0.001*
Types of GCs				<0.001*
1	20(21.1)	58(38.7)	1[Reference]	/
2	50(52.6)	76(50.7)	1.91(1.03-3.56)	0.04*
3	25(26.3)	16(10.7)	4.53(2.02-10.16)	<0.001*
Categories of GC				
Oral prednisolone	88(92.6)	139(92.7)	1.00(0.37-2.66)	0.99
Oral methylprednisolone	48(50.5)	25(16.7)	5.11(2.84-9.20)	<0.001*
Intravenous MPS	57(60.0)	90(60.0)	1.00(0.59-1.69)	>0.99
GC-related systemic ADRs	87(91.6)	117(78.0)	3.07(1.35-6.97)	0.01*
Growth	55(57.9)	48(32.0)	2.92(1.72-4.98)	<0.001*
BP	45(47.4)	47(31.3)	1.97(1.16-3.35)	0.01*
Musculoskeletal	41(43.2)	36(24.0)	2.40(1.39-4.18)	0.002*
Lg_GC use duration, days	2.8±0.4	2.4±0.5	4.02(3.00-7.03)	<0.001*
Height, cm	132.1±17.3	137.3±21.1	0.99(0.97-1.00)	0.05
SBP, mmHg	115.6±12.0	112.1±11.5	1.03(1.00-1.05)	0.03*
TG, mmol/L	2.0±1.4	1.7±1.0	1.26(1.00-1.58)	0.05

PSCC posterior subcapsular cataract, *OR* odds ratio, *GC* glucocorticoids, *MPS* methylprednisolone, *ADR* adverse drug reaction, *SBP* systolic blood pressure, *TG* triglyceride. *P values* were obtained with univariate logistic regression analysis. *P < 0.05, comparison between the groups with significance.

Table 3. Risk factors for the development of steroid-induced ocular hypertension.

Variable	SIOH (n=92)	Controls (n=150)	OR (95% CI)	*P* value
Age at present, years, mean±SD	9.0±3.3	10.0±3.6	0.90(0.84-0.98)	0.01*
Sex, *n*(%)				
Male	42(45.7)	84(56.0)	1[Reference]	/
Female	50(54.3)	66(44.0)	1.52(0.90-2.55)	0.12
Type of GC				<0.001*
Oral prednisolone	46(50.0)	111(76.6)	1[Reference]	/
Oral MPS	20(21.7)	17(11.7)	2.83(1.37-5.90)	0.01*
Intravenous MPS	26(28.3)	17(11.7)	3.69(1.83-7.44)	<0.001*
Dose of GC use, mg/kg*d	1.2±0.6	0.6±0.6	5.11(3.03-8.60)	<0.001*
GC-related systemic ADRs	82(89.1)	117(78.0)	2.31(1.08-4.95)	0.03*
Growth	46(50.0)	48(32.0)	2.13(1.25-3.62)	0.01*
Height, cm	127.5±19.8	137.3±21.1	0.98(0.97-0.99)	<0.001*
Weight, kg	31.8±13.6	37.4±15.2	0.97(0.96-0.99)	0.001*
CHOL, mmol/L	8.9±4.5±	6.8±3.3	1.15(1.07-1.24)	<0.001*
TG, mmol/L	2.4±2.1	1.7±1.0	1.45(1.15-1.84)	0.002*
HDL, mmol/L	2.3±1.1	1.8±0.8	1.88(1.33-2.67)	<0.001*
LDL, mmol/L	5.3±2.6	4.1±2.2	1.23(1.09-1.38)	<0.001*
ALB, mmol/L	31.8±9.8	35.2±11.8	0.97(0.95-1.00)	0.02*

SIOH steroid-induced ocular hypertension, *OR* odds ratio, *GC* glucocorticoids, *MPS* methylprednisolone, *ADR* adverse drug reaction, *CHOL* cholesterol, *TG* triglyceride, *HDL* high-density lipoprotein cholesterol, *LDL* low-density lipoprotein cholesterol, *ALB* albumin, *N* number of participants.

P values were obtained with univariate logistic regression analysis.

*P < 0.05, comparison between the groups with significance.

Online supplementary materials