Cohort profile

https://doi.org/10.6065/apem.2448272.136
Ann Pediatr Endocrinol Metab 2024;29:349-355

Annals of Pediatric Endocrinology & Metabolism
apem

Cohort profile: Multicenter Networks for Ideal Outcomes of Rare Pediatric Endocrine and Metabolic Diseases in Korea (OUTSPREAD study)

Yun Jeong Lee[1,*], Chong Kun Cheon[2,3,*], Junghwan Suh[4], Jung-Eun Moon[5], Moon Bae Ahn[6], Seong Hwan Chang[7], Jieun Lee[8], Jin Ho Choi[9], Minsun Kim[10,11,12], Han Hyuk Lim[13,14], Jaehyun Kim[15,16], Shin-Hye Kim[17], Hae Sang Lee[18], Yena Lee[19], Eungu Kang[20], Se Young Kim[21], Yong Hee Hong[22], Seung Yang[23], Heon-Seok Han[24], Sochung Chung[25], Won Kyoung Cho[26], Eun Young Kim[27], Jin Kyung Kim[28], Kye Shik Shim[29], Eun-Gyong Yoo[30], Hae Soon Kim[31], Aram Yang[32], Sejin Kim[33], Hyo-Kyoung Nam[34,35], Sung Yoon Cho[36], Young Ah Lee[1,16]

[1]Department of Pediatrics, Seoul National University Children's Hospital, Seoul, Korea; [2]Department of Pediatrics, Pusan National University Children's Hospital, Yangsan, Korea; [3]Department of Pediatrics, Pusan National University School of Medicine, Yangsan, Korea; [4]Department of Pediatrics, Yonsei University College of Medicine, Seoul, Korea; [5]Department of Pediatrics, Kyungpook National University Chilgok Hospital, Daegu, Korea; [6]Department of Pediatrics, College of Medicine, The Catholic University of Korea, Seoul, Korea; [7]Department of Pediatrics, Chonnam National University Hospital, Gwangju, Korea; [8]Department of Pediatrics, Inha University Hospital, College of Medicine, Inha University, Incheon, Korea; [9]Department of Pediatrics, Asan Medical Center Children's Hospital, University of Ulsan College of Medicine, Seoul, Korea; [10]Department of Pediatrics, Jeonbuk National University Medical School, Jeonju, Korea; [11]Department of Pediatrics, Jeonbuk National University Hospital, Jeonju, Korea; [12]Research Institute of Clinical Medicine of Chonbuk National University-Biomedical Research Institute of Jeonbuk National University Hospital, Jeonju, Korea; [13]Department of Pediatrics, Chungnam National University College of Medicine, Daejeon, Korea; [14]Division of Pediatric Endocrinology and Medical Genetics, Department of Pediatrics, Chungnam National University Hospital, Daejeon, Korea; [15]Department of Pediatrics, Seoul National University Bundang Hospital, Seongnam, Korea; [16]Department of Pediatrics, Seoul National University College of Medicine, Seoul, Korea; [17]Department of Pediatrics, Inje University Sanggye Paik Hospital, Seoul, Korea; [18]Department of Pediatrics, Ajou University School of Medicine, Suwon, Korea; [19]Department of Pediatrics, Hallym University Sacred Heart Hospital, Hallym University College of Medicine, Anyang, Korea; [20]Department of Pediatrics, Korea University Ansan Hospital, Ansan, Korea; [21]Department of Pediatrics, Bundang Jesaeng General Hospital, Daejin Medical Center, Seongnam, Korea; [22]Department of Pediatrics, Soonchunhyang University Bucheon Hospital, Soonchunhyang University College of Medicine, Bucheon, Korea; [23]Department of Pediatrics, Hanyang University Hospital, Hanyang University College of Medicine, Seoul, Korea; [24]Department of Pediatrics, Chungbuk National University Hospital, Cheongju, Korea; [25]Department of Pediatrics, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul, Korea; [26]Department of Pediatrics, St. Vincent's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea; [27]Department of Pediatrics, Chosun University Hospital, Chosun University College of Medicine, Gwangju, Korea; [28]Department of Pediatrics, Daegu Catholic University Medical Center, Daegu Catholic University School of Medicine, Daegu, Korea; [29]Department of Pediatrics, Kyung Hee University Hospital at Gangdong, Kyung Hee University School of Medicine, Seoul, Korea; [30]Department of Pediatrics, CHA University Bundang Medical Center, Seongnam, Korea; [31]Department of Pediatrics, College of Medicine, Ewha Womans University, Seoul, Korea; [32]Department of Pediatrics, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine, Seoul, Korea; [33]Department of Pediatrics, Kyemyung University Dongsan Hospital, Daegu, Korea; [34]Department of Pediatrics, Korea University College of Medicine, Seoul, Korea; [35]Department of Pediatrics, Korea University Guro Hospital, Seoul, Korea; [36]Department of Pediatrics, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea

Received: 8 November, 2024, Revised: 27 November, 2024, Accepted: 30 November, 2024
Address for correspondence: Young Ah Lee
Department of Pediatrics, Seoul National University Children's Hospital, 101, Daehak-ro, Jongno-gu, Seoul 03080, Korea
Email: nina337@snu.ac.kr, https://orcid.org/0000-0001-9179-1247
Address for co-correspondence: Sung Yoon Cho
Department of Pediatrics, Samsung Medical Center, Sungkyunkwan University School of Medicine, 81 Irwon-ro, Gangnam-gu, Seoul 06351, Korea
Email: nadri1217@naver.com, https://orcid.org/0000-0003-2913-059X
*These authors contributed equally to this study as co-first authors.

ISSN: 2287-1012(Print)
ISSN: 2287-1292(Online)

Rare endocrine diseases are complex conditions that require lifelong specialized care due to their chronic nature and associated long-term complications. In Korea, a lack of nationwide data on clinical practice and outcomes has limited progress in patient care. Therefore, the Multicenter Networks for Ideal Outcomes of Pediatric Rare Endocrine and Metabolic Disease (OUTSPREAD) study was initiated. This study involves 30 centers across Korea. The study aims to improve the long-term prognosis of Korean patients with rare endocrine diseases by collecting comprehensive clinical data, biospecimens, and patient-reported outcomes to identify complications and unmet needs in patient care. Patients with childhood-onset pituitary, adrenal, or gonadal disorders, such as craniopharyngioma, congenital adrenal hyperplasia (CAH), and Turner syndrome were prioritized. The planned enrollment is 1,300 patients during the first study phase (2022–2024). Clinical, biochemical, and imaging data from diagnosis, treatment, and follow-up during 1980–2023 were retrospectively reviewed. For patients who agreed to participate in the prospective cohort, clinical data and biospecimens will be prospectively collected to discover ideal biomarkers that predict the effectiveness of disease control measures and prognosis. Patient-reported outcomes, including quality of life and depression scales, will be evaluated to assess psychosocial outcomes. Additionally, a substudy on CAH patients will develop a steroid hormone profiling method using liquid chromatography-tandem mass spectrometry to improve diagnosis and monitoring of treatment outcomes. This study will address unmet clinical needs by discovering ideal biomarkers, introducing evidence-based treatment guidelines, and ultimately improving long-term outcomes in the areas of rare endocrine and metabolic diseases.

Keywords: Rare disease, Endocrine system diseases, Cohort studies, Treatment outcome, Child, Congenital adrenal hyperplasia, Craniopharyngioma, Turner syndrome

Highlights

- The OUTSPREAD study is a nationwide, multicenter initiative in Korea aimed at improving the long-term prognosis of patients with rare pediatric endocrine diseases by collecting comprehensive clinical, biochemical, and psychosocial data.
- The study prioritizes rare endocrine diseases such as craniopharyngioma, congenital adrenal hyperplasia, and Turner syndrome, aiming to enroll 1,300 patients during its initial phase (2022–2024) and collect data spanning from 1980 to 2023.
- By identifying ideal biomarkers and addressing unmet clinical needs, the study seeks to establish evidence-based guidelines and enhance the diagnosis, treatment, and quality of life for affected patients.

Introduction

Childhood-onset rare endocrine disorders affecting the pituitary, adrenal, and gonadal systems are complex conditions that necessitate lifelong specialized care. These disorders present unique challenges for pediatric patients as hormonal deficiencies frequently disrupt normal growth and pubertal progression.[1-3] Timely and appropriate hormone replacement therapy is therefore essential to ensure optimal growth and development in these patients.[4,5]

Craniopharyngioma (CRP), congenital adrenal hyperplasia (CAH), and Turner syndrome (TS) are representative examples of rare endocrine disorders affecting the pituitary, adrenal, and gonadal systems. Even with proper hormone replacement therapy, patients with these conditions are at a high risk for complications, including osteoporosis, metabolic syndrome, diabetes, cardiovascular disease, and infertility.[6-8] These complications can have a profound impact on the quality of life for both the patients and their caregivers. In addition, these patients often experience significant psychosocial challenges that arise from both the burden of chronic illness and the specific psychosocial issues inherent to each disorder.[9-11]

In Korea, research on childhood-onset rare endocrine disorders has been limited with most studies confined to single institutions.[12-15] Due to the rarity of these conditions, multicenter collaborations are crucial for generating meaningful research and improving patient outcomes. Globally, various initiatives have been established to address the challenges of rare endocrine disorders, including the German CRP Registry,[16] I-CAH Registry,[17] the InsighTS Registry,[18] and the European Reference Network for Rare Endocrine Conditions.[19] However, healthcare environments differ across countries necessitating research and guidelines tailored to local contexts. To date, there has not been a multicenter cohort study focused on rare endocrine disorders in Korea.

The Multicenter Networks for Ideal Outcomes of Rare Pediatric Endocrine and Metabolic Disease (OUTSPREAD) study is the first nationwide Korean multicenter cohort study focusing on rare pediatric endocrine disorders. The study aims to improve the long-term prognosis of patients by collecting comprehensive clinical data to identify complications and unmet needs. In addition, the study seeks to analyze biospecimens to discover novel biomarkers for disease management. Ultimately, the study's goal is to propose optimal hormone therapy regimens and develop clinical guidelines, thereby contributing to improved patient care and outcomes.

Study population and recruitment

Patients with childhood-onset endocrine disorders affecting the pituitary, adrenal, or gonadal systems were prioritized in

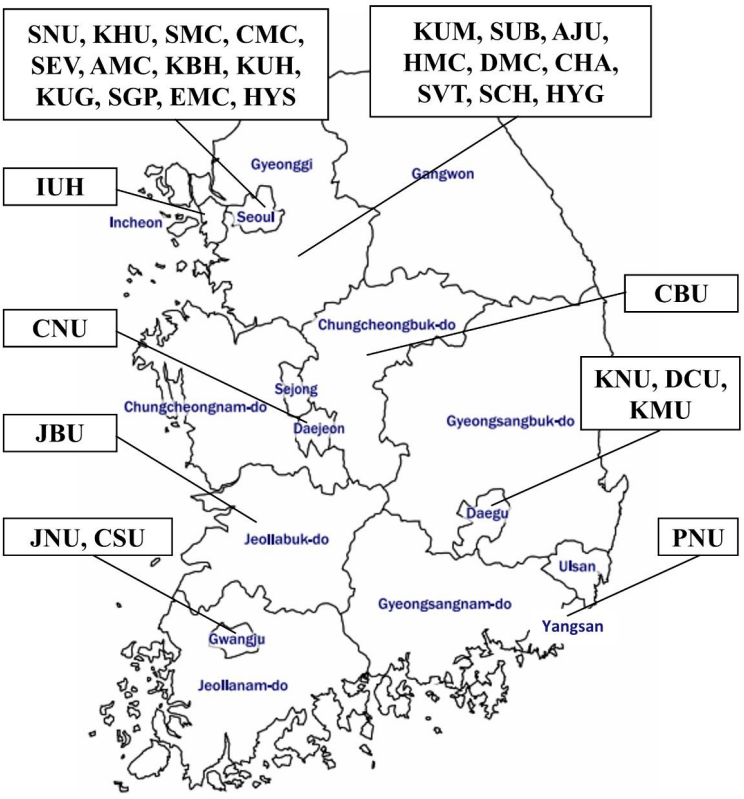

Fig. 1. Geographic distribution of participating hospitals. SNU, Seoul National University Children's Hospital; KHU, Kyung Hee University Hospital; SMC, Samsung Medical Center; CMC, Seoul St. Mary's Hospital; SEV, Severance Hospital; AMC, Asan Medical Center Children's Hospital; KBH, Kangbuk Samsung Hospital; KUH, Konkuk University Medical Center; KUG, Korea University Guro Hospital; SGP, Sanggye Paik Hospital; EMC, Ewha Womans University Medical Center; HYS, Hanyang University Seoul Hospital; KUM, Korea University Ansan Hospital; SUB, Seoul National University Bundang Hospital; AJU, Ajou University Hospital; HMC, Hallym University Sacred Heart Hospital; DMC, Bundang Jesaeng General Hospital; CHA, CHA Bundang Medical Center; SVT, St. Vincent's Hospital; SCH, Soonchunhyang University Bucheon Hospital; HYG, Hanyang University Guri Hospital; IUH, Inha University Hospital; CNU, Chungnam National University Hospital; CBU, Chungbuk National University Hospital; JBU, Jeonbuk National University Hospital; JNU, Chonnam National University Hospital; CSU, Chosun University Hospital; KNU, Kyungpook National University Chilgok Hospital; DCU, Daegu Catholic University Medical Center; KMU, Kyemyung University Dongsan Hospital; PNU, Pusan National University Children's Hospital.

this study. Individuals diagnosed with these conditions after 1980 and before the age of 18 years or those under the care of pediatric endocrinology departments were included. These patients were from 30 hospitals across Korea. The study was initially started at 16 hospitals in 2022 and was expanded to include 30 hospitals as of 2024. These participating hospitals are distributed across various regions of the country, including Seoul, Incheon, Gyeonggi, Chungcheong, Gyeongsang, and Jeolla, ensuring broad geographic representation for the study (Fig. 1).

The goal for 2022 to 2024 is to enroll a total of 1,300 participants spanning the three primary conditions: 250 patients with CRP, 350 with CAH, and 700 with TS. The inclusion criteria for each disease group are these. CRP patients with a confirmed pathological diagnosis following brain tumor surgery are included.[6] CAH patients diagnosed based on clinical presentation, biochemical tests, or genetic analysis[7] are also included. TS patients are included if presenting with a female phenotype and having an X chromosome deletion confirmed by chromosomal analysis.[8]

Cohort design and follow-up protocol

The cohort comprises two components: a retrospective cohort and a prospective cohort (Fig. 2). For the retrospective cohort, we conducted a comprehensive review of medical records spanning from 1980 to 2023, encompassing the period from initial diagnosis through each treatment course to the most recent follow-up. We identified specific time points for data collection from medical records for each disorder. These are detailed in Table 1. These time points are applicable to both the retrospective and prospective cohorts and ensure

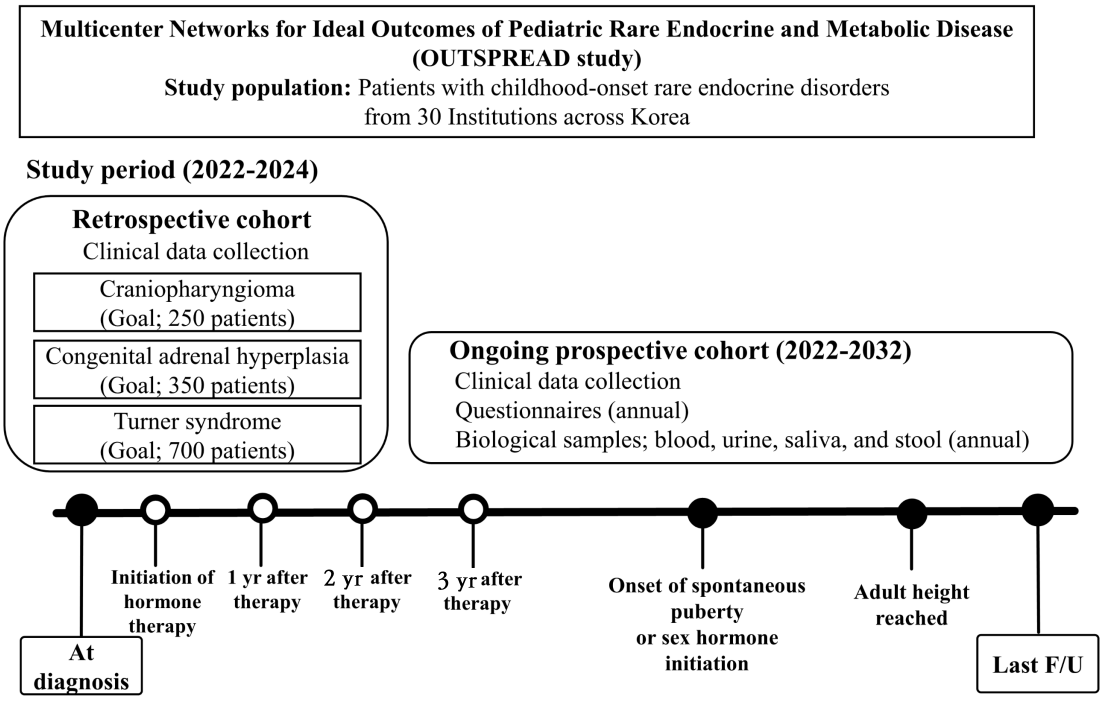

Fig. 2. Study design. F/U, follow-up.

Table 1. Key time points for clinical data collection by disease categories

Congenital adrenal hyperplasia	Craniopharyngioma	Turner syndrome
At diagnosis	At diagnosis	At diagnosis
Adrenal hormone replacement	Childhood GH therapy	GH therapy
Initiation	Initiation	Initiation
After 1 yr	After 1 yr	After 1 yr
After 2 yr	After 2 yr	After 2 yr
After 3 yr	After 3 yr	After 3 yr
GH therapy	Temporary discontinuation	Temporary discontinuation
Initiation	Restart of therapy	Restart of therapy
At the end of GH therapy	At the end of GH therapy	At the end of GH therapy
Spontaneous pubertal onset	Spontaneous pubertal onset	Spontaneous pubertal onset
Development of precocious puberty	Sex hormone initiation	Sex hormone initiation
Initiation of GnRH agonist therapy	Adult height reached	Adult height reached
At the end of GnRH agonist therapy	Adult GH therapy	Last visit
Adult height reached	Initiation	
Last visit	After 2 years	
	Recurrence of tumor	
	Last visit	

GH, growth hormone; GnRH, gonadotropin releasing hormone.

consistency in data collection across the study. Patients who provided informed consent for ongoing research participation are enrolled in the prospective cohort. These participants will undergo annual follow-up evaluations until 2032, allowing for an extended observation period of disease progression and treatment outcomes.

Clinical data collection

Clinical information collected included demographic information, birth history, family history, anthropometrics, karyotype or genotypes, disease course, hormone replacement therapy, other medical treatments, or surgical interventions. For anthropometric data, *z*-scores were calculated based on the 2017 Korean National Growth Charts.[20] Biochemical data, including hormone levels, both basal and stimulated, and fasting

Table 2. Multidimensional assessment parameters in the cohort study

Category	Measurements	Details
Clinical information	Demographics	Age, sex
	Birth history	Gestational week, birth weight
	Family history	Anthropometrics and puberty history of parents, family history of chronic disorders
	Initial presentation	Symptoms and signs
	Karyotype, genotype	If applicable
	Anthropometrics, physical examinations	Height, weight, body mass index, pubertal exam, presence of goiter, waist circumference, blood pressure, body composition
	Comorbidities or complications	Diabetes mellitus, dyslipidemia, hypertension, osteoporosis, psychosocial problems, adrenal rest tumor, menstrual disorders
	Hormone replacement therapy	GH, thyroid hormone, adrenal hormone, ADH, sex hormone
	Surgical therapy	Brain, cardiac, renal, gonads
	Other medical treatment	Medications for complications (diabetes, hypertension, dyslipidemia, psychiatric diseases)
Biochemical tests	Hormone profiles	Basal pituitary, thyroid, adrenal, sex hormone; stimulated hormone levels (GH, ACTH, TRH, GnRH- stimulation test; water deprivation test)
	Metabolic profiles or others	Fasting serum glucose, insulin, lipid profiles, glycated hemoglobin, liver function tests, electrolyte
Imaging (x-ray, US, CT, or MRI)	Bone age	-
	Brain	-
	Thyroid	-
	Cardiac	-
	Abdomen	Liver, kidney, adrenal, gonads
	Bone mineral density	Dual-energy x-ray absorptiometry
Questionnaires (prospective cohort)	Psychosocial factors	Participants: quality of life, depression scale Caregivers: quality of life, stress scale
	Medical history	Menstrual history, psychosocial disease history
	Family history	Diabetes, dyslipidemia, hypertension, cardiovascular disease, thyroid disorders
Biological samples (prospective cohort)	Blood, urine, saliva, stool	Annual collection

ADH, antidiuretic hormone; GH, growth hormone; ACTH, adrenocorticotropic hormone; TRH, thyrotropin-releasing hormone; GnRH, gonadotropin releasing hormone; US, ultrasonography; CT, computed tomography; MRI, magnetic resonance imaging.

metabolic profiles, were reviewed. Imaging studies, including bone age assessment and magnetic resonance imaging, computed tomography, and ultrasonography findings for brain, thyroid, cardiac, abdominal, and gonadal evaluations, were also analyzed. Detailed measurements for this cohort are presented in Table 2.

Questionnaires

Annual questionnaires assessing psychosocial factors, medical history, and family history are collected from participants in the prospective cohort study (Table 2). Psychosocial outcomes are measured using validated instruments, including the PedsQL 4.0 for quality of life[21] and age-appropriate depression scales (Korean version of the Children's Depression Inventory or Beck's Depression Inventory).[22,23] Caregiver quality of life is evaluated using the CarerQoL-7D Korean version,[24] and stress levels are measured using the Perceived Stress Scale-14.[25] The questionnaires also collect information on participants' menstrual and psychosocial disease history and family histories of chronic conditions including diabetes, dyslipidemia, cardiovascular diseases, and thyroid disorders.

Biological sample collection

For participants in the prospective cohort, blood, urine, saliva, and stool samples are collected annually alongside clinical data (Table 2). Participants are instructed to collect urine, saliva, and stool samples on the same day as blood sampling. These specimens will be used to identify potential biomarkers predictive of disease control and prognosis.

Substudy: Development of steroid hormone profiling for CAH diagnosis and monitoring

As part of this cohort study, we have been developing a comprehensive steroid hormone profiling method using liquid chromatography-tandem mass spectrometry. This approach addresses two critical needs in the management of CAH: (1) improving the differential diagnosis of various CAH types, particularly enzyme deficiencies beyond 21-hydroxylase deficiency (21OHD); and (2) enhancing the monitoring of

21OHD treatment. Annually collected biospecimens from patients with CAH will be used to validate the newly developed steroid hormone profiling method.

Conclusion

The OUTSPREAD cohort, the first nationwide study in Korea focusing on rare endocrine disorders, seeks to address the unmet needs of patients from childhood through adulthood. By collecting comprehensive clinical data and fostering collaboration across a national research network, this study aims to develop optimal management guidelines for rare pediatric endocrine diseases, potentially reducing long-term complications and enhancing patients' quality of life. The extensive biospecimen collection serves as a valuable resource for future biomarker research. This could lead to the discovery of novel diagnostic and prognostic indicators. Additionally, this research will provide for evidence-based policy reforms and facilitate the development of novel therapeutic approaches that ultimately enhance patient care and healthcare efficiency in the management of rare pediatric endocrine disorders.

Notes

Conflicts of interest: No potential conflict of interest relevant to this article was reported.
Funding: This research was supported and funded by SNUH Lee Kun-Hee Child Cancer & Rare Disease Project, Republic of Korea (grant number: 22C-007-0000).
Author contribution: Conceptualization: YJL, CKC, JS, JM, MBA, JL, JHC, MK, HHL, JK, SK, HSL, YL, EK, SYK, YH H, SY, HH, SC, WKC, EYK, JKK, KSS, EY, HSK, AY, SK, HN, SYC, YAL; Data curation: MBA, SHC, JL, MK, HHL, JK, HSL, YL, EK, SYK, HSK, AY, SK; Formal analysis: YJL; Funding acquisition: YAL; Methodology: CKC JS, JM, SHC, JHC, JK, SK, YHH, SY, HH, SC WKC, EYK, JKK, KSS, EY, HN, SYC; Project administration: YAL; Visualization: YJL; Writing - original draft: YJL; Writing - review & editing: YJL, CKC, JS, JM, MBA, SHC, JL, JHC, MK, HHL, JK, SK, HSL, YL, EK, SYK, YH H, SY, HH, WKC, EYK, JKK, KSS, EY, HSK, AY, SK, HN, SYC, YAL
ORCID
Yun Jeong Lee: 0000-0003-2847-2643
Chong Kun Cheon: 0000-0002-8609-5826
Junghwan Suh: 0000-0002-2092-2585
Jung-Eun Moon: 0000-0001-9786-7898
Moon Bae Ahn: 0000-0003-1108-2788
Seong Hwan Chang: 0000-0002-3497-4626
Jieun Lee: 0000-0002-7386-0015
Jin Ho Choi: 0000-0003-1196-7826
Minsun Kim: 0000-0002-3617-7823
Han Hyuk Lim: 0000-0002-5297-5913
Jaehyun Kim: 0000-0002-0203-7443
Shin-Hye Kim: 0000-0003-0413-122X
Hae Sang Lee: 0000-0002-9684-4042
Yena Lee: 0000-0001-8740-8049
Eungu Kang: 0000-0001-6544-3599
Se Young Kim: 0000-0003-4921-2795
Yong Hee Hong: 0000-0002-4676-8483
Seung Yang: 0000-0002-3380-6962
Heon-Seok Han: 0000-0003-0012-2545
Sochung Chung: 0000-0002-7655-2691
Won Kyoung Cho: 0000-0003-0918-0565
Eun Young Kim: 0000-0002-3073-5222
Jin Kyung Kim: 0000-0003-0018-851X
Kye Shik Shim: 0000-0002-8004-151X
Eun-Gyong Yoo: 0000-0002-6452-655X
Hae Soon Kim: 0000-0002-6976-6878
Aram Yang: 0000-0003-4731-3701
Sejin Kim: 0000-0002-5974-5109
Hyo-Kyoung Nam: 0000-0003-1512-2062
Sung Yoon Cho: 0000-0003-2913-059X
Young Ah Lee: 0000-0001-9179-1247

References

1. Otte A, Muller HL. Childhood-onset craniopharyngioma. J Clin Endocrinol Metab 2021;106:e3820-36.
2. Claahsen-van der Grinten HL, Speiser PW, Ahmed SF, Arlt W, Auchus RJ, Falhammar H, et al. Congenital adrenal hyperplasia-current insights in pathophysiology, diagnostics, and management. Endocr Rev 2022;43:91-159.
3. Gravholt CH, Viuff M, Just J, Sandahl K, Brun S, van der Velden J, et al. The changing face of Turner syndrome. Endocr Rev 2023;44:33-69.
4. Ahmid M, Ahmed SF, Shaikh MG. Childhood-onset growth hormone deficiency and the transition to adulthood: current perspective. Ther Clin Risk Manag 2018;14:2283-91.
5. Kim JH, Chae HW, Chin SO, Ku CR, Park KH, Lim DJ, et al. Diagnosis and treatment of growth hormone deficiency: a position statement from Korean Endocrine Society and Korean Society of Pediatric Endocrinology. Endocrinol Metab (Seoul) 2020;35:272-87.
6. Gan HW, Morillon P, Albanese A, Aquilina K, Chandler C, Chang YC, et al. National UK guidelines for the management of paediatric craniopharyngioma. Lancet Diabetes Endocrinol 2023;11:694-706.
7. Speiser PW, Arlt W, Auchus RJ, Baskin LS, Conway GS, Merke DP, et al. Congenital adrenal hyperplasia due to steroid 21-hydroxylase deficiency: an Endocrine Society Clinical Practice Guideline. J Clin Endocrinol Metab 2018;103:4043-88.
8. Gravholt CH, Andersen NH, Christin-Maitre S, Davis SM, Duijnhouwer A, Gawlik A, et al. Clinical practice guidelines for the care of girls and women with Turner syndrome. Eur J Endocrinol 2024;190:G53-151.
9. Sterkenburg AS, Hoffmann A, Gebhardt U, Warmuth-Metz M, Daubenbuchel AM, Muller HL. Survival, hypothalamic obesity, and neuropsychological/psychosocial status after childhood-onset craniopharyngioma: newly reported long-

term outcomes. Neuro Oncol 2015;17:1029-38.
10. Yau M, Vogiatzi M, Lewkowitz-Shpuntoff A, Nimkarn S, Lin-Su K. Health-related quality of life in children with congenital adrenal hyperplasia. Horm Res Paediatr 2015;84:165-71.
11. Liedmeier A, Jendryczko D, van der Grinten HC, Rapp M, Thyen U, Pienkowski C, et al. Psychosocial well-being and quality of life in women with Turner syndrome. Psychoneuroendocrinology 2020;113:104548.
12. Park SH, Lee YJ, Cheon JE, Shin CH, Jung HW, Lee YA. The effect of hypothalamic involvement and growth hormone treatment on cardiovascular risk factors during the transition period in patients with childhood-onset craniopharyngioma. Ann Pediatr Endocrinol Metab 2023;28:107-15.
13. Kim JH, Choi JH, Kang E, Kim YM, Lee BH, Yoo HW. Long-term consequences of congenital adrenal hyperplasia due to classic 21-hydroxylase deficiency in adolescents and adults. Exp Clin Endocrinol Diabetes 2017;125:196-201.
14. Lim SG, Lee YA, Jang HN, Kong SH, Ahn CH, Kim SW, et al. Long-term health outcomes of Korean adults with classic congenital adrenal hyperplasia due to 21-hydroxylase deficiency. Front Endocrinol (Lausanne) 2021;12:761258.
15. Park SY, Kim SJ, Lee M, Lee HI, Kwon A, Suh J, et al. Neurocognitive and psychosocial profiles of children with Turner syndrome. Ann Pediatr Endocrinol Metab 2023;28:258-66.
16. Boekhoff S, Bogusz A, Sterkenburg AS, Eveslage M, Muller HL. Long-term effects of growth hormone replacement therapy in childhood-onset craniopharyngioma: results of the German Craniopharyngioma Registry (HIT-Endo). Eur J Endocrinol 2018;179:331-41.
17. Tseretopoulou X, Bryce J, Chen M, McMillan M, Lucas-Herald AK, Ali SR, et al. The I-CAH Registry: a platform for international collaboration for improving knowledge and clinical care in congenital adrenal hyperplasia. Clin Endocrinol (Oxf) 2024;101:397-404.
18. Kanakatti Shankar R, Carl A, Law JR, Bamba V, Brickman WJ, Prakash SK, et al. Inspiring new science to guide healthcare in Turner syndrome: rationale, design, and methods for the InsighTS Registry. Am J Med Genet A 2024;194:311-9.
19. Ali SR, Bryce J, Cools M, Korbonits M, Beun JG, Taruscio D, et al. The current landscape of European registries for rare endocrine conditions. Eur J Endocrinol 2019;180:89-98.
20. Kim JH, Yun S, Hwang SS, Shim JO, Chae HW, Lee YJ, et al. The 2017 Korean National Growth Charts for children and adolescents: development, improvement, and prospects. Korean J Pediatr 2018;61:135-49.
21. Varni JW, Burwinkle TM, Seid M, Skarr D. The PedsQL 4.0 as a pediatric population health measure: feasibility, reliability, and validity. Ambul Pediatr 2003;3:329-41.
22. Kovacs M. Children's depression inventory (CDI and CDI 2). In: Encyclopedia clinical psychology. Hoboken (NJ): Wiley, 2014;1-5.
23. Lee EH, Lee SJ, Hwang ST, Hong SH, Kim JH. Reliability and validity of the Beck Depression Inventory-II among Korean adolescents. Psychiatry Investig 2017;14:30-6.
24. Brouwer WB, van Exel NJ, van Gorp B, Redekop WK. The CarerQol instrument: a new instrument to measure care-related quality of life of informal caregivers for use in economic evaluations. Qual Life Res 2006;15:1005-21.
25. Lee EH, Chung BY, Suh CH, Jung JY. Korean versions of the Perceived Stress Scale (PSS-14, 10 and 4): psychometric evaluation in patients with chronic disease. Scand J Caring Sci 2015;29:183-92.