

# Characteristics and Treatment Outcomes of Transition among Patients with Inflammatory Bowel Disease

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**Purpose:** This study aimed to assess disease characteristics and outcomes of transition in patient care among adolescent patients with inflammatory bowel disease (IBD).

**Materials and Methods:** Data from patients younger than 18 years who were diagnosed with IBD (Crohn's disease, ulcerative colitis, or intestinal Behçet's disease) were investigated. We categorized the patients into two groups: transition IBD group (Group A, diagnosed in pediatric care followed by transfer to/attendance in adult IBD care) and non-transition group (Group B, diagnosed and followed up in pediatric care or adult IBD care without transfer).

**Results:** Data from a total of 242 patients [Group A (n=29, 12.0%), Group B (n=213, 88.0%)] were analyzed. A significantly higher number of patients was diagnosed at an earlier age in Group A than in Group B ( $p<0.001$ ). Group A patients had more severe disease in terms of number of disease flare ups ( $p=0.011$ ) and frequency of bowel-related complications ( $p<0.001$ ). Multiple linear regression analysis showed that Group B patients had more medical non-compliance than Group A patients ( $\beta=2.31$ ,  $p=0.018$ ). After transition, IBD-related admission frequency, emergency admission frequency, disease flare frequency, and medical non-compliance were significantly improved.

**Conclusion:** The transition IBD group had more severe disease. Medical non-compliance was lower in the transition IBD group. Clinical outcomes improved after transition.

**Key Words:** Transition, inflammatory bowel disease, adherence, compliance, outcome

## INTRODUCTION

Inflammatory bowel diseases (IBD), including ulcerative colitis (UC), Crohn's disease (CD), and intestinal Behçet's disease (BD), are chronic, relapsing, and remitting immune-mediated inflammatory disorders of the gastrointestinal tract. Approximately 25% of IBD cases are diagnosed in childhood or ado-

lescence, and evidence has shown that the incidence of IBD cases diagnosed in pediatric years is increasing.<sup>1,2</sup> One concern with IBD in young people is that more extensive and severe presentations are seen<sup>3</sup>: young patients usually experience more surgeries or hospitalizations and receive intensive treatments, such as immune-modulatory or biological therapies, more often than adult patients. Therefore, problems with growth and psychosocial and sexual development are frequent.<sup>4</sup> Schooling and employment are also negatively affected.

Usually, pediatric IBD patients are transferred to an adult care unit at the age of 16–18 years in Western countries.<sup>5</sup> Transfer from a pediatric to an adult IBD care unit usually occurs while the patient is in disease remission. Successful transition involves gradual changes in disease-specific knowledge, attitude toward treatment, clinic attendance behavior, and medical compliance, and careful systemic and constructed transitional care has been shown to be related with better disease-specific treatment outcomes.<sup>6</sup> The optimal goal of the transition process is

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to provide sustainable, comprehensive, and medically appropriate health care to IBD patients. However, standard guidelines and sufficient data related to the transition process are lacking. In particular, studies addressing disease characteristics and treatment outcomes in unselected cohorts of IBD transition groups are limited.

Adolescent IBD patients carry genetic and environmental differences from their older counterparts, as well as parental influences, which can affect the treatment process. These differences are associated with differences in disease characteristics and treatment processes and outcomes. Accordingly, determination of IBD-related transition group outcomes is important, as transition patients might benefit from different approaches to therapy relative to those requiring solely pediatric or solely adult care. However, few data regarding IBD-related outcomes after transition are available.

This study aimed to assess disease characteristics, treatment processes, and outcomes in an IBD transition group. Specifically, we sought to investigate the major clinical outcomes after transition.

## MATERIALS AND METHODS

### Study population

This study was conducted as a retrospective review of medical records of patients under 18 years of age who were diagnosed as having IBD at Severance Hospital, Yonsei University College of Medicine in Seoul, Korea between November 2005 and December 2015. A total of 385 patients were included. Twelve patients were lost to follow-up or were being followed up in other institutions (4 patients) before the age of 18. These patients were excluded from the study. Patients without a definite diagnosis of IBD (31 patients) and those who had not been prescribed IBD medications were excluded (18 patients). Also, both patients under the age of 18 years at the last follow-up time (42 patients) and patients with a follow-up period under 18 months (36 patients) were excluded. Lastly, patients taking total enteral nutrition from the time of diagnosis to the end of the study were excluded from the study because it was likely that other medications could not be administered and compared between pediatric and adult clinic practices.

We categorized patients into three groups, transition IBD group (diagnosed in pediatric care followed by transfer to/attendance in adult IBD care), pediatric IBD care group (diagnosed and followed in pediatric care without transfer to adult IBD care), and adult IBD care group (diagnosed and followed in adult IBD care). Pediatric IBD care and adult IBD care groups were grouped together into a non-transition group (Group B) and compared as the control group of the transition group (Group A).

### Disease characteristics and treatment outcome variables

We collected written and electronic patient demographic data, including age at registration in a pediatric or adult clinic, transition care, previous smoking history, IBD family history, biological and non-biological treatments, intestinal complications (fistula, abscess, stenosis, or colorectal dysplasia or cancer), Montreal classification at presentation, and number of surgeries or hospital admissions. Reasons for admission were categorized as follows: 1) acute flare, such as medical or surgical emergency situations, and 2) elective admission for surgery (e.g., seton insertion) and elective procedures and investigations (i.e., disease-reassessment, infusion, or planned colonoscopy). Extra-intestinal manifestations of IBD and drug side effects or complications were assessed. Data on laboratory findings included the level of hemoglobin, platelet count, erythrocyte sedimentation rate, and C-reactive-protein level.

For evaluating disease activity, survey modifications of the Crohn's Disease Activity Index and the Colitis Activity Index (S-CDAI, S-CAI) were calculated. Remission was defined as S-CDAI  $\leq 150$  for CD and S-CAI  $\leq 4$  for UC.<sup>7</sup> For pediatric patients, Pediatric Crohn's Disease Activity Index score or Pediatric Ulcerative Colitis Activity Index score was calculated.<sup>8</sup> Disease Activity Index for Intestinal Behçet's Disease score was calculated for intestinal BD patients.<sup>9</sup>

Finally, we reviewed electronic medical charts to assess the frequency of not taking prescribed drugs and non-attendance at clinics.

### Transition process and period

At our institution, during the transition period, medical/surgical histories and past/current disease status of all patients are reviewed by pediatric and adult IBD specialists and nurses. A "transition passport" is provided from the pediatric IBD clinic to fully prepare for transition. Furthermore, both pediatric and adult IBD specialists discuss each patient's case in detail during multidisciplinary meetings prior to transition to establish a comprehensive therapeutic plan. Patients are educated on the disease characteristics and potential complications, importance of IBD medications, side effects of IBD medications, and the need for regular follow-up for disease monitoring. Last, pediatricians accompany patients to the adult IBD clinic.

The start of transition was defined as the first registration to the transition clinic. Age at completing transition was defined as the age at which the patient left pediatric care and started visiting adult clinics.

### Medical non-compliance

This study was designed as a retrospective study, and there was no self-reported drug compliance reports for patients. Instead, we referred to previous studies in which visit nonadherence and medication nonadherence were classified together to assess medical non-compliance.<sup>10-12</sup> Visit nonadherence was

defined as patients who had a scheduled follow-up appointment but did not appear. Medication nonadherence was defined as failure to adhere to medication dosages as documented in the medical records by the caregivers and included patients.

We defined medical non-compliance as the sum of the frequency of visit nonadherence to the frequency of medication nonadherence in this study.

### Primary and secondary end points

The primary end point of this study was disease characteristics and outcomes of the transition group that were different from those of the non-transition group. In addition, major clinical outcome differences before and after transition were assessed. The secondary end point was differences in treatment compliance between transition and non-transition patients.

### Data analysis

All data were analyzed using SPSS statistical package 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as means and standard deviations (SD) or medians and interquartile ranges (IQR) or ranges. Categorical variables are presented as frequencies (%). In order to compare transition and non-transition groups, for continuous variables, Welch's two sample t-test was applied considering mean and SD values as descriptive measures. For discrete variables, we employed the Mann-Whitney U test with medians and 1st and 3rd quantiles as summary statistics. For dichotomized variables, we performed the chi-squared test, reporting total frequency and percentage. The adjusted *p* values for disease characteristics and clinical outcomes were calculated by utilizing score tests based on proportional odds logistic regression models, which is equivalent to the Mann-Whitney Wilcoxon test. Then, multiple linear regression analysis was utilized to identify independent variables associated with medical non-compliance. All covariates with marginal significance, including follow-up duration, number of disease flare ups, the frequency of IBD related complications, number of admissions required, number of emergency admissions required, and the use of IBD medications (aminosalicylates, immunomodulators, methotrexate, corticosteroids, and infliximab) were entered into our multiple linear regression model. For variable selection, we employed forward selection, backward elimination, and step-wise selection methods. Last, a proportional odds logistic regression model was used to compare major clinical outcomes before and after transition adjusted by the variable follow-up duration. All *p* values were from two-sided statistical tests, and values of *p*<0.05 were considered statistically significant.

### Ethical considerations

The study received full institutional ethics approval by Institutional Review Board of Severance Hospital (IRB number: 4-2021-1059).

## RESULTS

### Baseline characteristics of the study population

Initially, 385 subjects who were diagnosed as having UC, CD, or intestinal BD under the age of 18 years were included. Of these, 177 were initially diagnosed in the pediatric IBD clinic, and 208 were initially diagnosed in the adult IBD clinic. After excluding patients with non-specific diagnosis or inflammation associated with other secondary causes (infection or ischemia), those who were under 18 years on the last day of the study period or those with a follow-up duration less than 18 months, data from a total of 242 patients [Group A (n=29, 12.0%), Group B (n=213, 88.0%)] were included in the final analysis (Fig. 1). The mean age at transition was 19 (range, 12–21) years, and median pre- and post-transfer follow-up durations were 53.9 (range, 6.2–112.5) and 23.6 (range, 5.9–125.5) months, respectively. In the case of a patient transitioned at the age of 12, the parents wanted the patient to be early transitioned from pediatrics to adult gastroenterology. A significantly higher number of patients were diagnosed at an earlier age in Group A than Group B (median age 14 vs. Group B, 16, *p*<0.001). The baseline data between the two groups are listed in Table 1.

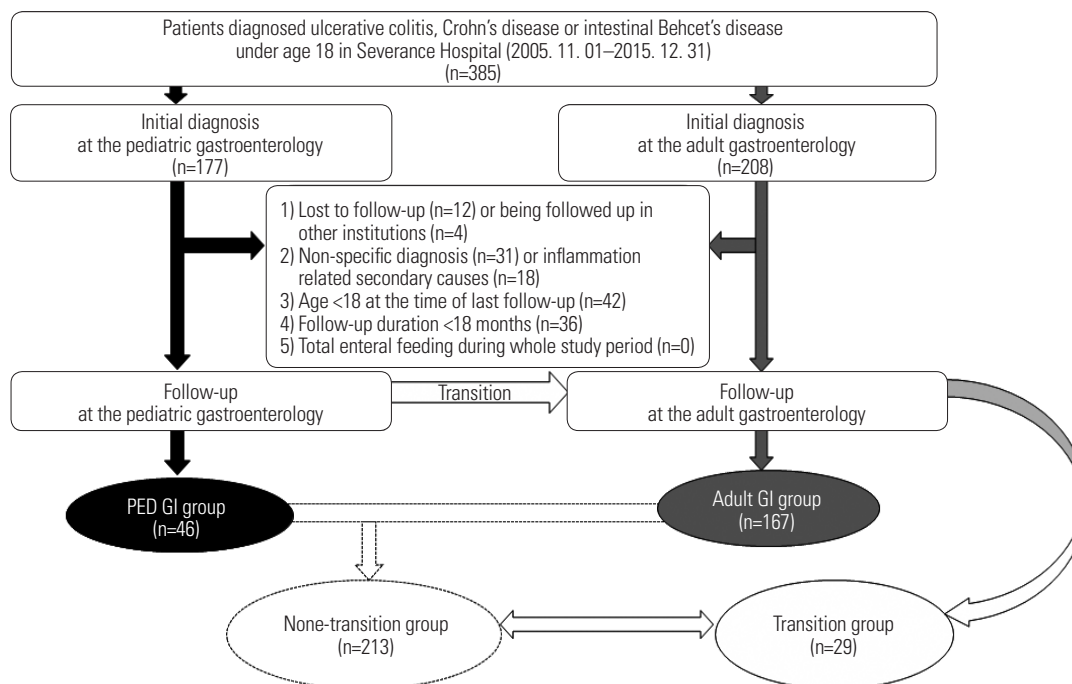
### Disease characteristics and treatments

Group A patients were followed up for a significantly longer duration [median duration (months), 80 vs. Group B, 65 months, *p*=0.001]. A statistically significant difference in follow-up duration between the two groups could have an important effect on the results. Therefore, the clinical results and treatment processes between the two groups were compared and analyzed according to disease duration. As a result, patients in Group A were shown to experience a significantly higher number of disease flare-ups and less medical non-compliance than those in Group B (median number 3 vs. Group B, 2, *p*=0.011 and median number 4 vs. Group B, 6, *p*=0.005). IBD-related bowel complications were more frequent in Group A patients [8 (27.6) vs. Group B, 17 (8.0), *p*<0.001]. However, there was no significant difference in terms of the numbers of total admissions, emergency admissions, and IBD-related surgeries during the study period between the two groups (Table 2).

As for medications, significantly fewer Group A patients were treated with aminosalicylates [20 (69.0%) vs. Group B, 195 (91.5%), *p*=0.001]. In contrast, the numbers treated with steroids [28 (96.6%) vs. Group B, 151 (70.9%), *p*=0.006], immunomodulators [25 (86.2%) vs. Group B, 139 (65.3%), *p*=0.040], methotrexate [3 (10.3%) vs. Group B, 11 (5.2%), *p*<0.001], or infliximab [17 (58.6%) vs. Group B, 43 (20.2%), *p*<0.001] were significantly higher among Group A patients than Group B patients (Table 3). There was no remarkable difference in drug complications between the two groups (*p*=0.236).

### Medical non-compliance

Linear regression analysis showed that medical non-compli-



**Fig. 1.** Flow chart of the study. PED, pediatric; GI, gastroenterology; UC, ulcerative colitis; CD, Crohn's disease; BD, Behçet's disease.

**Table 1.** Baseline Characteristics of the Study Population (n=242)

Variables	Transition group (n=29)	None-transition group (n=213)	p value
Demographic data			
Current age (yr)	21 (20–22)	21 (20–24)	NS
Age at diagnosis (yr)	14 (13–15)	16 (15–17)	<0.001
Male sex	20 (69.0)	147 (69.0)	NS
Smoking history	1 (3.5)	3 (1.4)	NS
IBD family history	0 (0.0)	1 (0.5)	NS
Type of IBD			NS
Crohn's disease	15 (51.3)	124 (58.2)	
Ulcerative colitis	9 (31.0)	63 (29.6)	
Intestinal Behçet's disease	5 (17.2)	26 (12.2)	
Laboratory data at transition			
Hemoglobin (mg/L)	12.51±2.43	12.72±1.89	NS
Leukocyte count (×10 <sup>9</sup> /L)	6.75±3.42	7.78±2.19	NS
Platelet count (×10 <sup>9</sup> /L)	375.05±174.62	325.86±207.73	NS
Erythrocyte sedimentation rate (mm/h)	15.04±6.78	21.94±20.21	NS
C-reactive protein (mg/L)	5.78±9.82	4.67±8.32	NS

IBD, inflammatory bowel disease; NS, non-significant.

Variables are expressed as means±SD, median (interquartile range), or n (%).

ance was associated with a longer follow-up duration ( $\beta=0.06$ ,  $p<0.001$ ), more disease flare ups ( $\beta=0.43$ ,  $p=0.006$ ), higher aminosalicylate usage ( $\beta=0.03$ ,  $p=0.001$ ), and greater steroid usage ( $\beta=0.14$ ,  $p=0.001$ ). In particular, medical non-compliance was significantly high in Group B ( $\beta=2.31$ ,  $p=0.018$ ) (Table 4).

**Table 2.** Disease Characteristics and Clinical Outcomes (n=242)

Outcomes	Transition group (n=29)	None-transition group (n=213)	p value*
Deaths with all causes	0 (0.0)	0 (0.0)	NS
Number of disease flares	3 (2–5)	2 (1–3)	0.011
Number of admissions needed	2 (1–4)	1 (0–3)	NS
Number of emergency admissions needed	1 (0–2)	0 (0–1)	NS
Number of surgeries	0 (0–0)	0 (0–0)	NS
Use of total parenteral nutrition	8 (27.6)	49 (23.0)	NS
Extraintestinal manifestation of IBD	6 (13.8)	24 (11.3)	NS
Complications of IBD (perforation, bowel obstruction, or stricture)	8 (27.6)	17 (8.0)	<0.001
Number of medical non-compliance	4 (3–6)	6 (3–11)	0.005

IBD, inflammatory bowel disease; NS, non-significant.

Variables are expressed as medians (interquartile range) or n (%).

\*p value adjusted by the variable follow-up duration.

### Changes in clinical outcomes before and after transition

When comparing the follow-up duration before and after transition in Group A, the follow-up duration before transition was statistically significantly longer than the follow-up duration after transition. There might have been more chance of poor outcomes before transition because follow-up duration before transition was longer than that after transition. Therefore, we used the professional odds logistic regression model and calibrated the follow-up duration to compare major clinical outcomes before and after transition. In result, total admission



**Table 3.** Medical Treatments (n=242)

Type of medication	Transition group (n=29)	None-transition group (n=213)	p value*
Aminosalicylate	20 (69.0)	195 (91.5)	0.001
Immunomodulator (AZA/6-MP)	25 (86.2)	139 (65.3)	0.040
Methotrexate	3 (10.3)	11 (5.2)	<0.001
Corticosteroid	28 (96.6)	151 (70.9)	0.006
Biologic agents			
Infliximab	17 (58.6)	43 (20.2)	<0.001
Adalimumab	0 (0.0)	22 (10.3)	NS
Colchicine	2 (6.9)	12 (5.6)	NS
Antibiotics (metronidazole/ciprofloxacin)	21 (72.4)	116 (54.5)	NS
Drug intolerance/complication	3 (10.3)	13 (6.1)	NS

AZA, azathioprine; 6-MP, 6-mercaptopurine; NS, non-significant.

Variables are expressed as n (%).

\*p value adjusted by the variable, follow-up duration.

**Table 4.** Independent Variables of Medical Non-Compliance (n=242)

Variables	$\beta$	95% CI	p value
Follow-up duration (months)	0.06	0.03–0.08	<0.001
Number of disease flares	0.43	0.13–0.74	0.006
Aminosalicylate use	0.03	0.01–0.05	0.001
Steroid use	0.14	0.06–0.22	0.001
Non-transition group	2.31	0.41–4.21	0.018

CI, confidence interval.

number (pre-transition, median number, 2 vs. post-transition, 0,  $p=0.004$ ), emergency admission frequency (pre-transition, median number, 1 vs. post-transition, 0,  $p=0.020$ ), disease flares (pre-transition, median number, 2 vs. post-transition, 0,  $p<0.001$ ), and medical non-compliance (pre-transition, median number, 3 vs. post-transition, 1,  $p<0.001$ ) were significantly improved after transition among Group A patients. Otherwise, the total number of surgeries did not differ before and after transition (pre-transition, median number, 0 vs. post-transition, 0,  $p=0.205$ ) (Table 5).

## DISCUSSION

In previous studies, transition was associated with poorer medical adherence among pediatric liver transplant recipients and type I diabetes mellitus (DM) patients.<sup>13</sup> However, a study on congestive heart disease patients reported better medical adherence with higher clinical attendance rates during and after the transition process.<sup>14</sup> Similarly, coordinated transition brought beneficial effects on medical adherence to adolescents with juvenile rheumatoid arthritis.<sup>15</sup> However, there have been few studies documenting that an effective transition process can improve clinical outcomes while promoting medical adherence among adolescent patients with IBD. Jeganathan, et al.<sup>6</sup> pro-

**Table 5.** Differences in Clinical Outcomes before and after Transition (n=29)

Variables	Pre-transition	Post-transition	p value*
Number of needing admissions	2 (0–16)	0 (0–4)	0.004
Number of needing emergency admissions	1 (0–3)	0 (0–3)	0.020
Number of surgeries	0 (0–2)	0 (0–1)	0.205
Number of disease flares	2 (1–16)	0 (0–4)	<0.001
Medical non-compliance	3 (0–32)	1 (0–15)	<0.001

Variables are expressed as medians (range).

\*p value adjusted by the variable follow-up duration.

spectively compared medical non-adherence among a transition group (initially managed by pediatric gastroenterologists and transferred to adult gastroenterologists), a young adult group (always managed by adult gastroenterologists), and a pediatric group (always managed by pediatric gastroenterologists) of IBD patients. These researchers reported that transition patients did not elicit worse adherence than the young adult group patients.<sup>6</sup> However, a survey by Fu, et al.<sup>16</sup> showed that adolescents with IBD had low overall medical adherence despite adequate disease-specific knowledge. In addition, a survey by Bennett, et al.<sup>17</sup> revealed no significant differences in medical compliance, disease complications, surgeries, admission rate, or number of disease flares up between transition patients and age- and sex-matched patients who received treatment only in an adult IBD clinic.

However, to our knowledge, there have been no previous studies concerning disease characteristics, clinical outcomes, and medical adherence of IBD patients during transition periods, particularly in Asia. IBD patients in Asia have several differences, compared with IBD patients in Western countries. The incidence and prevalence of CD and UC appear to be lower in Asia and the Middle East.<sup>18</sup> As a result, social awareness of IBD is low, patients attempt to hide the disease more frequently, and interest in and knowledge of treatment are low. Also, in the East, there is a greater disease stigma, and patients tend to endure the disease alone.<sup>19</sup>

According to the results of this study, the prevalence of IBD-related bowel complications and incidence of disease flares were significantly higher in the transition group than the non-transition group with IBD. This can be interpreted as indicating that more clinically active or symptomatic patients are more likely to undergo transition. In a previous study, intestinal complications tended to be more frequent in IBD patients with pediatric period onset.<sup>20</sup> According to another previous study, surgery and admission rates were significantly higher in the transition group than adult controls.<sup>10</sup> However, in our study, there was no statistical difference in the numbers of elective and emergency hospitalizations between the transition and non-transition groups of IBD patients. Also, in South Korea, IBD is considered an adult disease, and there are many drugs that have been recognized for insurance benefits only in adults.

Therefore, adult IBD patient cases can appear more complicated.<sup>21</sup> Therefore, to ensure a successful transition process, multidisciplinary care should be performed through precise understanding of individual patient disease status, obstacles for transition, and possible outcomes. In addition, efforts are needed to share and improve information on treatment plans with patients, their families, and both pediatric and adult IBD care providers.

Among medical treatments, the frequency of steroids, immunomodulator, methotrexate, and infliximab administration was significantly higher in the transition group in our study, while aminosalicylate was administered infrequently. These findings could be related with the higher incidences of IBD-related bowel complications and disease flares in the transition group patients. Systemic steroids, immunosuppressants, and biologics are used commonly in severe or refractory diseases<sup>22,23</sup> and can be associated with severe disease activity and progress in the transition group. In contrast to our findings, previous studies have shown no significant differences in drug administration between transition and non-transition groups.<sup>6,10,15</sup>

Importantly, we found medical non-compliance to be significantly lower in transition group patients. Non-adherence to medications in IBD is related to a 5-fold increase in relapse risk.<sup>6</sup> Medication adherence rates for adolescents with IBD were reported at about 50%–75% in a previous study.<sup>24</sup> Similarly, medical adherence rates in adolescents with other chronic diseases, such as type I DM and bronchial asthma, were reported to be 40%–80%.<sup>25,26</sup> A significant increase in medical non-adherence during transition is well known in type I DM, as well as renal transplantation subjects.<sup>27,28</sup> Contrary to the results of our work, medical adherence between transition groups and non-transition groups showed no significant difference in several previous studies.<sup>6,16,17</sup> Also, some studies have shown that transition groups have higher medical non-adherence rates than non-transition groups.<sup>10,15</sup> The difference between previous studies and the results of this study is probably related to patients in the transition group having a longer average follow-up period and a higher level of disease activity than non-transition patients. Consequently, patients in the transition group showed greater trust or dependence on the medical staff and a better understanding of the need for drugs than did patients in the non-transition group. Also, patients in the transition group have higher self-determination and self-confidence in treatment process. In addition, pediatric and adult IBD physicians were involved cooperatively in increasing drug compliance during the transition process by organizing disease progress or treatment plans and understanding disease characteristics, treatment progress, medication or surgical treatment, and future treatment plans. In particular, the process of converting from pediatric- to adult-centered treatment had a significant impact on the study results by changing the focus of treatment from growth, puberty, and nutrition to cancer surveillance and fertility. In doing so, the focus of care can be shifted from family-

centered to individuals, and patients have to participate actively and voluntarily in their treatment.

Another intriguing point in our study is that the transition process could have a positive change in major clinical outcomes, such as disease flare ups and medical non-compliance. These results do not simply mean that an adult IBD clinic is better than a pediatric IBD clinic, but suggest that an appropriate transition and multidisciplinary clinic may be beneficial to IBD care. Both disease flare ups and medical non-compliance were significantly improved after transition, similar to the results of Cole, et al.<sup>10</sup> in 2015. Also, a retrospective study published by Otto, et al.<sup>15</sup> showed improved disease remission rates and planned outpatient attendance rates after transition. Throughout the transition process, education about disease and treatment is provided via communication between patients and IBD medical staff and increases patient drug compliance and willingness to treat, leading to fewer disease flares and hospitalization rates. In a prospective study of 59 patients with transition, adolescents held significantly stronger beliefs that planned disease evaluation and treatment were necessary and had positive attitudes toward their prescribed medicine.<sup>16</sup> Previous studies of type 1 diabetes patients have shown that the transition process reduced diabetes complications and hospitalization rates.<sup>29</sup>

Our study, for the first time, revealed the disease characteristics, treatment outcomes, and medical adherence in a transition group with IBD patients in East Asia. Unlike Western countries, major life events, including financial independence and moving away from family and home, tend to occur at later ages in East Asia countries. As such, Asian adolescents are thought to be more dependent on parents when making decisions.<sup>19</sup> Likewise, in the context of IBD care, major decisions tend to be a shared family opinion, especially since there is a financial consideration with regard to the high cost of treatment.<sup>30</sup> Therefore, there is bound to be a difference in the course of treatment and compliance of patients in the East and the West, indicating the importance of individualized transition according to country. Another strength of this study is that the number of samples in the study group was higher than in previous studies. This study also has a difference in that previous papers studied in the West included only CD and UC patients among IBD, while this study included intestinal BD, which is relatively common in Northeast Asia.

However, some limitations of this study should be considered. First, this was a retrospective study conducted in a single institution and was not only uncontrolled but not randomized. Hence, although it might indicate trends, firm conclusion and generalization of the results should be validated. Thus, further multi-institution-based, controlled, randomized, prospectively designed research should be performed based on our study. Practically, most institutions in Korea do not have a documented transition protocol and lack the manpower or resources involved for transition care.<sup>31,32</sup> Structured transition guidelines have been published by major international gastroenterology

societies in the West, including the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) (2002) and European Crohn's and Colitis Organization (ECCO) (2017).<sup>33,34</sup> In Northeast Asia, the Japanese Society for Pediatric Gastroenterology, Hepatology, and Nutrition (JSPGHAN) recently published guidelines for transition of IBD patients.<sup>19</sup> In Korea, there is no officially documented guideline for transition clinics or care for IBD patients. There have been studies reporting that an effective transition care system and protocol can promote medical adherence and disease outcomes.<sup>6,35</sup> Therefore, based on our study, more research on transition groups of IBD patients should be conducted, and appropriate guidelines should be established to improve the lifelong clinical results of the transition group. Meanwhile, there were cases where records of disease extent (32%) and disease activity (27%) at diagnosis were missing, and drug compliance surveys were investigated using only medical charts or the number of outpatient cancellations without questionnaires or telephone interviews as in other studies.<sup>6,16,17</sup> In addition, we did not investigate socioeconomic factors and educational background, which can influence clinical outcomes and medical non-compliance. Therefore, systematic data collection and analysis are needed through a prospective study. Finally, in the comparison of major clinical results before and after transition, there may be limitations in interpreting the results because the follow-up period after transition was significantly shorter than the follow-up period before transition (pre-transition, median follow-up duration, 54 months vs. post transition, 24 months,  $p < 0.01$ ). Thus, we used the professional odds logistic regression model to correct the difference in follow-up duration before and after transition, and compared and analyzed the main clinical outcomes.

IBD is a chronic, lifelong disease that repeats cycles of improvement and deterioration. Also, disease-associated morbidity can be high. Therefore, an efficient and systematic transition from pediatric to adult clinic is indispensable. Our study revealed that a transition group of IBD patients had a longer follow-up duration and a higher number of disease flare ups with bowel-related complications than did the non-transition group. Meanwhile, non-attendance at the clinic and drug non-compliance were significantly lower among transition group patients. Indeed, after transition, medical noncompliance and several clinical outcomes were improved. Multicenter-oriented prospective studies should be carried out in the future to help create efficient transition protocols or guidelines for IBD groups in Korea.

## AUTHOR CONTRIBUTIONS

**Conceptualization:** Jae Hee Cheon. **Data curation:** Eun Jin Yoo. **Formal analysis:** Eun Jin Yoo and Sang-Hoon Cho. **Funding acquisition:** Jae Hee Cheon. **Investigation:** Eun Jin Yoo and Soo Jung Park. **Methodology:** Jae Hee Cheon and Won Ho Kim. **Project administration:** Jae Hee Cheon and Tae Il Kim. **Resources:** Eun Jin Yoo and Jae Hee

Cheon. **Software:** Eun Jin Yoo. **Supervision:** Sang-Hoon Cho, Soo Jung Park, Tae Il Kim, Won Ho Kim, and Jae Hee Cheon. **Validation:** Sang-Hoon Cho and Jae Hee Cheon. **Visualization:** Eun Jin Yoo. **Writing—original draft:** Eun Jin Yoo. **Writing—review & editing:** Jae Hee Cheon. **Approval of final manuscript:** all authors.

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