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# Education status and household income in relation to constipation prevalence in Japanese patients with ulcerative colitis Running title: Socioeconomic status and constipation in UC

**Sen Yagi**
Saiseikai Imabari Hospital
**Shinya Furukawa**
shinya.furukawa@gmail.com

Ehime University
**Teruki Miyake**
Ehime University Graduate School of Medicine
**Osamu Yoshida**
Ehime University Graduate School of Medicine
**Kazuhiro Tange**
Ehime University Graduate School of Medicine
**Shogo Kitahata**
Ehime Prefectural Central Hospital
**Tomoyuki Ninomiya**
Ehime Prefectural Central Hospital
**Masakazu Hanayama**
Matsuyama Shimin Hospital
**Seiyuu Suzuki**
Sumitomo Besshi Hospital
**Naozumi Shibata**
Ehime Prefectural Niihama Hospital
**Hidehiro Murakami**
Saiseikai Matsuyama Hospital
**Katsuhisa Ohashi**
**Hideomi Tomida**
Ehime University Hospital
**Yasunori Yamamoto**
Ehime University Hospital
**Eiji Takeshita**

Ehime University Graduate School of Medicine
**Yoshio Ikeda**
Ehime University Hospital
**Yoichi Hiasa**
Ehime University Graduate School of Medicine

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## Abstract

# Background

Constipation frequently occurs in patients with ulcerative colitis (UC). Although socioeconomic status has been linked to constipation in the general population, limited data are available regarding this association among individuals with UC. The present study investigated the relationship between educational attainment, household income, and the prevalence of constipation in Japanese patients with UC.

# Methods

A total of 289 patients with UC were enrolled. Constipation was defined according to the Rome I criteria and/or current use of laxative medications. Educational attainment and household income were categorized into three levels using a self-administered questionnaire. Endoscopic remission was defined as a Mayo endoscopic subscore (MES) of 0. Clinical remission (CR) was defined as the absence of rectal bleeding and a normal stool frequency of fewer than three bowel movements per day.

# Results

Constipation was identified in 11.8% of participants. The proportion of patients with constipation decreased across increasing educational levels (low: 29.6%; middle: 10.9%; high: 7.6%). After adjustment for potential confounders, lower educational attainment remained significantly associated with constipation (adjusted odds ratio [OR]: 4.00 [95% confidence interval (CI): 1.15–14.5], *p* for trend = 0.044). In contrast, no statistically significant association was observed between household income and constipation.

# Conclusion

In this cohort of Japanese patients with UC, lower educational attainment was independently associated with a higher prevalence of constipation, whereas household income showed no significant relationship with constipation.

## Background

Constipation is a common gastrointestinal condition that negatively affects quality of life and has been associated with cardiovascular disease, chronic kidney disease, and increased mortality [1–10]. Previous epidemiological studies have suggested that poor socioeconomic status, such as low income and low educational attainment, may increase the incidence of constipation[1–10]. However, evidence on this

issue remains limited, and a clear association between socioeconomic status and constipation has yet to be established.

Ulcerative colitis (UC) is a chronic inflammatory bowel disease, and its prevalence is increasing worldwide [11]. Socioeconomic status is considered an important factor in UC, as treatment can significantly impact daily life and impose substantial financial burdens[12]. Lower socioeconomic status is known to contribute to worse clinical outcomes across a range of diseases[13] and may similarly affect outcomes in patients with inflammatory bowel disease[14–24]. In a previous study, we reported that higher educational attainment was independently and positively associated with mucosal healing (MH) in older patients with UC, but not in younger patients. In contrast, no association was found between household income and clinical outcomes, regardless of age[25].

UC is typically characterized by diarrhea with bloody stools and abdominal pain due to accelerated intestinal transit and intestinal hypersensitivity associated with inflammation of the colonic mucosa. However, constipation with fecal impaction is sometimes observed in patients with UC [26]. This seemingly contradictory phenomenon may be explained by inflammatory colonic motility disorders, damage to intestinal innervation, and the development of parietal fibrosis over time[27]. Recognizing these abnormalities early is crucial to avoid inappropriate clinical and therapeutic approaches, as they may result in delayed diagnosis or incomplete treatment efficacy. Furthermore, constipation can occur during both active disease and remission phases, significantly impairing quality of life in patients with UC. Therefore, understanding constipation in UC is clinically important.

However, few studies have examined UC and constipation. Therefore, in the present study, we hypothesized that socioeconomic status may influence the prevalence of constipation in UC patients. Understanding this association is important for addressing health disparities, reducing medical costs, and improving education and awareness.

The purpose of this study was to investigate the association between education status, household income, and the prevalence of constipation in Japanese UC patients.

# Methods

Ethics approval and consent to participate

This cross-sectional analysis was conducted using baseline data derived from an ongoing prospective cohort. The study protocol was reviewed and approved by the Clinical Trial Review Committee of the Ehime University Graduate School of Medicine (approval number: 1505011). All procedures adhered to the ethical standards outlined in the Declaration of Helsinki (1964) and its later amendments. Written informed consent was obtained from all participants by trained research personnel. The study was prospectively registered in the University Hospital Medical Information Network (UMIN000051334 Registration date: 13 June 2023). Clinical trial number: not applicable.

## Study population

This study included 387 patients with UC who received clinical management, either as inpatients or outpatients, at the Department of Gastroenterology and Metabology, Ehime University Graduate School of Medicine, and its affiliated institutions in Ehime Prefecture, Japan, between 2015 and 2019[28]. The diagnosis of ulcerative colitis was established according to characteristic endoscopic features and confirmed by clinical, radiologic, and histopathological assessments. All participants gave informed consent and were capable of completing a self-administered questionnaire.

## Measurements

Information on lifestyle and socioeconomic factors, including smoking status, alcohol consumption, educational attainment, and household income, was obtained through a self-administered questionnaire.

The questionnaire used in this study was specifically developed for this research. An English version of the questionnaire is provided as Supplementary File 1. Clinical details such as medication use for UC, disease extent, and duration were extracted from medical records. Participants were classified as current smokers if they reported active smoking at the time of the survey, irrespective of the number of cigarettes smoked. Similarly, individuals were considered current drinkers if they indicated having a regular drinking habit, regardless of the frequency or amount consumed.

An endoscopy specialist evaluated the endoscopic activity of UC by total colonoscopy. Clinical remission (CR) was defined as the absence of rectal bleeding and no abnormally high frequency of stools (fewer than 3 times/day)[29]. Clinical symptoms were evaluated by a certified gastroenterologist. In this study, a Mayo Endoscopic Score (MES) of 0 was defined as MH[30].One endoscopy specialist evaluated both MES and MH while blinded to socioeconomic status.

## Definition of constipation

Constipation was defined based on the Rome I criteria, evaluated through a self-administered questionnaire that also recorded the use of laxatives. Participants meeting the Rome I definition or reporting medication use for constipation were considered to have constipation.

## Statistical analysis

Education status was classified into three categories: (1) low education (junior high school and high school), ≤12 years; (2) moderate education (junior college, vocational technical school, and 4-year college dropout), 12–16 years; and (3) high education (college or graduate school), 16 years or more. Household income was also divided into three categories: (1) low income, ≤2,999,999 Japanese

yen/year; (2) moderate income, 3,000,000–5,999,999 Japanese yen/year; and (3) high income ≥6,000,000 Japanese yen/year. Age was categorized into two groups: younger (<51 years old) and older (≥51 years old), based on the mean age (50.6 years).

We estimated crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for constipation according to education and income using logistic regression. Multivariable models adjusted for age, sex, prednisolone use, alcohol consumption, smoking, BMI, disease duration, and disease extent. Analyses were performed with SAS 9.4 (SAS Institute, Cary, NC, USA), and two-tailed p values <0.05 were considered statistically significant.

# Results

Baseline characteristics of the participants are summarized in Table 1. Among the 289 patients with UC, 58.5% were male. The mean age was 50.6 years, and the mean body mass index (BMI) was 22.49 kg/m². Constipation was observed in 11.8% of the cohort. The proportions of patients achieving complete mucosal healing (MES 0) and clinical remission were 24.9% and 57.6%, respectively. With regard to educational attainment, 50.0% (n = 149) had ≤12 years of education, 21.1% (n = 63) had 12–16 years, and 28.9% (n = 86) had >16 years. For household income, 21.1% were classified as low income, 46.6% as middle income, and 32.2% as high income. No significant association was detected between age and household income level (data not shown).

Table 2 shows the crude and multivariable-adjusted odds ratios (ORs) with corresponding 95% confidence intervals (CIs) for the association between socioeconomic indicators and constipation. The prevalence of constipation decreased progressively with increasing educational level (29.6% in the low education group, 10.9% in the middle group, and 7.6% in the high group). After adjustment for potential confounders, low educational attainment remained significantly associated with constipation (adjusted OR 4.00, 95% CI 1.15–14.5; p for trend = 0.044). In contrast, constipation prevalence across household income categories was 14.3% in the low-income group, 8.1% in the middle-income group, and 12.1% in the high-income group. No statistically significant association was identified between household income and constipation.

# Discussion

The relationship between UC and constipation is significant. While mucosal inflammation in UC was traditionally thought to affect only the colonic mucosa and submucosa, increasing evidence suggests that in some patients, particularly those with long-term disease, the inflammatory state may progress deeper, potentially causing progressive fibrosis of the colon[31]. These abnormalities affect colonic function, particularly its motor activity. Past studies have reported cases where patients with this disease paradoxically present with complaints of fecal impaction or constipation[32]. This aspect has been relatively overlooked by researchers for many years due to its comparatively low incidence, but it has recently been re-examined in the literature[33].

Therefore, this study demonstrates that educational level is one factor related to constipation in ulcerative colitis. In this cross-sectional study of patients with UC, lower educational attainment was identified as an independent factor associated with the prevalence of constipation. No significant

association was observed between household income and constipation. To the best of our knowledge, this is the first study to report such an association in patients with UC, underscoring the potential contribution of socioeconomic factors in symptom development.

First, the relationship between income and constipation warrants discussion. Previous studies have demonstrated conflicting results. In Australia, constipation was found to be notably more prevalent among individuals in the most socioeconomically disadvantaged groups, with incidence rates of 1.83 in men and 1.68 in women. [1] Similarly, a cross-sectional study in Nigeria reported a significantly higher prevalence of constipation among those in lower social classes ($p$ = 0.013)[34].These findings suggest that economic disadvantage may increase the risk of constipation, possibly through mechanisms such as poor diet, inadequate healthcare access, heightened stress, and unhealthy lifestyle habits.

However, opposing findings also exist. For example, a study conducted in Beijing reported no significant differences in constipation prevalence according to literacy levels[35],and research from New York found no association between income and constipation in either men or women[36]. These discrepancies may reflect differences in healthcare systems, cultural factors, or definitions of socioeconomic status. Thus, the association between income and constipation remains inconclusive.

In the present study, no association was identified between household income and constipation in patients with UC. Nevertheless, it is plausible that low-income individuals may face multiple indirect factors, including dietary patterns, healthcare accessibility, psychosocial stress, and lifestyle habits, that could predispose them to constipation.

Second, the association between education level and constipation also remains inconsistent across the literature. Some studies have reported a higher prevalence of constipation among individuals with lower educational attainment, including research conducted in China[4], the United States[5,6],and Iran[37]. In these populations, additional factors such as advanced age, sedentary lifestyle, poor dietary habits, and higher body mass index were also identified as contributing risks. Conversely, other studies, such as one from Thailand, found no significant association between education and constipation[38]. These conflicting results may in part reflect differences in health literacy and self-management skills, which can influence diet, exercise, and health-seeking behaviors.

Although the precise mechanisms linking education and constipation are not yet fully understood, several hypotheses have been proposed. Individuals with lower education levels may be more likely to engage in irregular eating habits, consume nutritionally imbalanced diets, lead physically inactive lifestyles, and experience chronic psychosocial stress. Socioeconomic disadvantage, encompassing both income and education, is known to affect chronic disease outcomes through its cumulative impacts on health behaviors and access to care. Notably, the association between socioeconomic status and the clinical course appears to differ between UC and Crohn's disease. While lower socioeconomic status has been associated with poorer outcomes in Crohn's disease, its effect on UC remains less clear and appears to vary by country[13]. In Japan, universal health insurance and public subsidies for UC treatment likely mitigate the financial barriers to care, diminishing the observable

impact of income on clinical outcomes. Nevertheless, given the global disparities in healthcare systems, further research is necessary to clarify the influence of socioeconomic factors on constipation and other clinical outcomes in patients with UC.

This study has several limitations. First, owing to its cross-sectional design, causal inferences between socioeconomic factors and constipation cannot be established. Second, information on socioeconomic status was obtained through self-administered questionnaires, and the precision of the reported educational attainment and household income remains uncertain. Furthermore, possible income fluctuations associated with hospitalization or treatment were not evaluated. Third, data on employment status—an essential component of socioeconomic position—were unavailable in this cohort. Fourth, differences in healthcare delivery systems across countries may influence the observed relationship between socioeconomic status and constipation, thereby limiting the external validity of our findings. Finally, potential selection bias cannot be ruled out; the relatively low prevalence of biologic therapy use suggests that the study participants may not completely represent the overall population of patients with UC in Japan.

# Conclusion

Among Japanese UC patients, lower education was independently associated with the prevalence of constipation, but not household income. Future studies using larger cohorts and incorporating qualitative methods are needed to better understand how socioeconomic factors affect constipation.

# Declarations

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### Conflicts of interest

The authors have no financial conflicts of interest.

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### Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Ethics approval and consent to participate

The study protocol was approved by the Clinical Trial Review Committee of the Ehime University Graduate School of Medicine (approval number: 1505011). Written informed consent was obtained from all participants by trained research personnel. The study was prospectively registered in the University Hospital Medical Information Network (UMIN000051334 Registration date: 13 June 2023).

### Consent for publication

Not Applicable.

### Author contributions

Conceptualization: SY, SF, TM, ET, YI, YH; Methodology: SY, SF; Formal analysis: SF; Investigation: SY, SF, TM; Data curation: TM, ET, YI.; Writing-original draft: SY, SF; Editing: TM, OY, KT, SK TN, SS, NS, HM, KO, HT, YY, ET, YI; Visualization: SF; Supervision: YH; Project administration: SF, ET, YI, YH. All authors gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

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# Tables

Table 1. Clinical characteristics of 289 study participants

| Variables | Mean ± SD or n (%) |
|---|---|
| Age (years) | 50.6 ± 16.0 |
| Male (%) | 169 (58.5) |
| Duration of UC (years) | 8.1 ± 8.3 |
| BMI | 22.49 ± 4.45 |
| Current smoking | 21 (7.3) |
| Current drinking | 118 (40.8) |
| Medication for UC | |
| 5-Aminosalicylates | 262 (91.0) |
| Prednisolone | 58 (20.1) |
| Thiopurines | 42 (14.5) |
| TNF-*α monoclonal antibody* | 15 (5.2) |
| Mayo Endoscopic Subscore (MES) | 1.22 ± 0.91 |
| Mucosal healing (MES 0) | 72 (24.9) |
| Clinical remission | 167 (57.6) |
| Constipation (%) | 34 (11.8) |
| Medication for constipation (%) | 29 (10.0) |

BMI, body mass index; UC, ulcerative colitis; SD, standard deviation; TNF, tumor necrosis factor; Other: right-sided, segmental colitis, and postoperative patients (lack of any preoperative medical records for postoperative patients)

Table 2. Crude and adjusted odds ratios and 95% confidence intervals for education status and household income in relation to constipation

| Variable | Prevalence (%) | Crude OR (95% CI) | Adjusted OR (95% CI) |
|---|---|---|---|
| Constipation | | | |
| Education | | | |
| Low | 8/27 (29.6) | 5.12 (1.60–17.33) | 4.00 (1.15–14.52) |
| Middle | 20/183 (10.9) | 1.49 (0.61–4.22) | 1.36 (0.54–3.93) |
| High | 6/79 (7.6) | 1.00 | 1.00 |
| *p* for trend | | | 0.041 |
| Household income | | | |
| Low | 16/112 (14.3) | 1.21 (0.54–2.83) | 1.09 (0.45–2.67) |
| Middle | 7/86 (8.1) | 0.64 (0.23–1.72) | 0.65 (0.22–1.77) |
| High | 11/91 (12.1) | 1.00 | 1.00 |
| *p* for trend | | | 0.80 |

Adjusted for age, current drinking, current smoking, BMI, and mucosal healing, OR, odds ratio; CI, confidence interval

## Supplementary Files

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- SupplementaryFile1.docx