



Incidence and Prevalence of Inflammatory Bowel Disease across Asia

Jihye Park^{1,2} and Jae Hee Cheon^{1,2,3}

¹Department of Internal Medicine, ²Institute of Gastroenterology, ³Brain Korea 21 PLUS Project for Medical Science, Yonsei University College of Medicine, Seoul, Korea.

Inflammatory bowel diseases (IBD), including ulcerative colitis (UC) and Crohn's disease (CD), are chronic inflammatory disorders of the gastrointestinal tract caused by interactions between genetic, environmental, immunological, and microbial factors. While the incidence and prevalence of IBD in Asian populations were relatively lower than those in Western countries, they appear to be gradually increasing. A Westernized diet, high socioeconomic status, improvement of hygiene, and development of vaccination could affect the increases in IBD incidence and prevalence in Asian countries. This review describes the latest trends in the incidence and prevalence of IBD in Asia. Studying the epidemiology of IBD in Asia may unravel the etiopathogenesis of and risk factors for IBD.

Key Words: Inflammatory bowel disease, Crohn's disease, ulcerative colitis, incidence, prevalence

INTRODUCTION

Inflammatory bowel diseases (IBD), including ulcerative colitis (UC) and Crohn's disease (CD), are chronic idiopathic inflammatory disorders of the gastrointestinal tract. In the last 20th century, IBD was regarded as a Western disease in North America and Europe, not in South America, Eastern Europe, Asia, or Africa. However, the incidence and prevalence of IBD have been increased globally in the 21st century.¹ Although still lower than that in Western countries, cases of IBD in Asia are rising.²⁻⁶ Research has shown that genetic susceptibility and environmental triggers can modulate immunologic responses and that microbial composition in the gut can contribute to increases in IBD development.⁷ The increased disease burden of IBD in Asia could be associated with changes in environmental

factors, such as improvement in hygiene, socioeconomic status changes, and Westernized diets. We will describe the latest trends in the incidence and prevalence of IBD in Asia.

EPIDEMIOLOGICAL RESEARCH METHODS

Cross-sectional and cohort studies have been performed to investigate the epidemiology of IBD. Therein, the selection of study groups is important to minimize selection bias. Although a hospital-based study could minimize the recall of information, the study population may not be representative of the true population. To overcome generalizability, a population-based study can be performed to minimize heterogeneity. This approach may better represent a particular geographic area and reflect important information about the population-based characteristics of IBD: this can be valuable because a population of IBD patients in a given geographic area could present a unique disease phenotype. However, it can be difficult to accurately identify case groups among the entire population, and doing so may require tremendous effort and cost. Meanwhile, big data studies using nationwide or state wide databases could inform the epidemiology of IBD for an entire population, whether that be a single nation or worldwide. Big data studies, however, are limited to retrospective population studies, which are not available to obtain detailed information about disease courses

Received: October 6, 2020 **Revised:** December 2, 2020

Accepted: December 7, 2020

Corresponding author: Jae Hee Cheon, MD, PhD, Department of Internal Medicine, Yonsei University College of Medicine, 50-1 Yonsei-ro, Seodaemun-gu, Seoul 03722, Korea.

Tel: 82-2-2228-1990, Fax: 82-2-393-6884, E-mail: Geniushee@yuhs.ac

•The authors have no potential conflicts of interest to disclose.

© Copyright: Yonsei University College of Medicine 2021

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

or medications.

Recent epidemiological studies have demonstrated rising disease burden for IBD in developing countries, including Asia countries. Since individual epidemiological studies have their own strengths and limitations, it is necessary to select an appropriate method with which to interpret them according to the subject and purpose of the study. In this review, we will cover previous epidemiologic studies of IBD in Asia, including hospital-based, population-based, and big data-based studies.

EPIDEMIOLOGY OF IBD IN ASIAN MIGRANTS

Research evaluating changes in IBD epidemiology between first- and second-generation immigrants has highlighted the importance of environmental factors affecting the development of IBD. The research on IBD epidemiology in Asian migrants is summarized in Table 1. The first study on the impact of migration on IBD focused on Bangladeshi immigrants who settled in Tower Hamlets, East London. The incidence of UC among Bangladeshi residents in the London Borough of Tower Hamlets from 1972 to 1989 was very low (1.8 cases/10⁵/year).⁸ The incidence of UC among Bangladeshi residents in Tower Hamlets increased from 2.4 cases/10⁵/year in 1981–1989 to 8.2 cases/10⁵/year in 1997–2001.⁹ The incidence of CD among Bangladeshi residents in Tower Hamlets also increased gradually throughout the 1970s (1.2 cases/10⁵/year), 1980s (2.3 cases/10⁵/year), and 1990s (7.3 cases/10⁵/year).^{9,10} Bangladeshi immigrants had a higher incidence of IBD than the local population, thus supporting the significant role of environmental factors in the development of IBD.

Another study related to South Asian migrants addressed Indian, Gujarati or Punjabi, immigrants who settled in Leicester city. The incidence of UC in the South Asian community in Leicester city was high from 1991 to 1994, even higher than that in the European community (17.2 cases/10⁵/year vs. 7.0 cases/10⁵/year, respectively).¹¹ The prevalence of UC in the South Asian community in Leicester city was also higher than that in Europeans (135 cases/10⁵/year vs. 90.8 cases/10⁵/year, respectively).¹² The risk of UC in this particular community was even higher than that for individuals of European descent living in the same area, suggesting that the pattern of UC followed an indigenous population after only one generation. Meanwhile, a recent study revealed three novel human leucocyte antigen (HLA)-independent single-nucleotide polymorphisms (SNPs) for UC in the north Indian population,¹³ support the notion that the genetic background in a certain ethnic group can contribute to the development of IBD. In a recent epidemiologic study in 2016, the incidence of UC in an Indian group was higher (20.5 cases/10⁵/year) than that in a Pakistani group (11.2 cases/10⁵/year) and white European group (7.5 cases/10⁵/year) in the multi-ethnic United Kingdom, although the study popu-

lation was predominantly born in the United Kingdom.¹⁴ Interestingly, the prevalence of CD in the same South Asian community in Leicester city was lower than that in Europeans (33.2 cases/10⁵/year vs. 75.8 cases/10⁵/year, respectively).¹² Indeed, research supports a difference between UC and CD epidemiology in immigrants: early life dysbiosis events, such as caesarean section, increased hygiene, and repeated antibiotics, are related to the risk of CD, whereas late dysbiosis events are related to the risk of UC.¹⁵ Further studies of intestinal microbiota and environmental factors will be needed to confirm this hypothesis. In summary, north Indian migrants in Leicester city face a higher risk of UC, but not CD, compared to European descents. Further studies investigating the interplay among several factors, including intestinal microbiota, diet, and other environmental causes, may be crucial to explain this.

Canada also has a large South Asian population. The incidence of IBD of immigrants in Ontario, Canada was lower than that of nonimmigrants from 1994 to 2009 (7.3 cases/10⁵/year vs. 23.9 cases/10⁵/year).¹⁶ Younger age at immigration increased the risk of IBD immigrants. Also, children of immigrants from the Middle East/North Africa, South Asia, Sub-Saharan Africa, and North America/Western Europe had a similar risk of IBD as children of nonimmigrants; however, the incidence remained lower among children of immigrants from other regions. The early exposure to high risk environment with specific genetic background could increase the risk IBD.

All of these results support the role of environmental factors in IBD development. Immigration could alter the gut microbiome composition. It is known that changes in diet have the greatest effect on changes in the composition of intestinal microbes. The microbiome of Thailand immigrants who settled in the United States experience a loss of gut microbiome diversity and shifts from *Prevotella* dominance to *Bacteroides* dominance.¹⁷ Immigration-related microbiome changes started upon arrival to the United States and increased with a longer duration of residence in the United States and across generations. Future research should focus on identifying and modifying environmental risk factors to reduce the risk of IBD.

EPIDEMIOLOGY OF IBD IN INDIGENOUS ASIANS

East Asia

The research on IBD epidemiology in indigenous Asian is summarized in Table 2. In Japan, the prevalence rates of UC and CD in the nationwide registration system were 7.85 cases/10⁵/year and 1.86 cases/10⁵/year, respectively, in 1985.¹⁸ The incidence rate of UC was very low in 1990 (0.36–0.40 cases/10⁵/year).¹⁹ The prevalence rates of UC and CD in a survey of nationwide hospitals were also low in 1991 (18.1 cases/10⁵/year and 5.9/10⁵/year, respectively).²⁰ The prevalence rates of UC and CD in the nationwide registration system in Japan in-

Table 1. Incidence and Prevalence of Inflammatory Bowel Diseases in Asian Migrants to Western Countries

Author	Ethnic group	Region of residence	Study method	Dates	Ulcerative colitis		Crohn's disease	
					Incidence (cases/10 ⁵ person-years)	Prevalence (cases/10 ⁵ persons)	Incidence (cases/10 ⁵ person-years)	Prevalence (cases/10 ⁵ persons)
Jayanthi, et al. 1992 ⁸	Bangladeshi	Tower Hamlet, London, England	Data from a regional hospital	1972–1989	1.8			
Probert, et al. 1992 ¹⁰	South Asians (Hindus, Sikhs, Moslems)	Leicestershire, England	Community-based survey	1989		135		33
Probert, et al. 1993 ¹²	Bangladeshi	Tower Hamlet, London, England	Data from a regional hospital	1972–1989			1.2 (1970s) 2.3 (1980s)	
Carr and Mayberry 1999 ¹¹	South Asians	Leicester, England	Community-based survey	1991–1994	17.2			
Tsironi, et al. 2004 ⁹	Bangladeshi	Tower Hamlet, London, England	Data from a regional hospital	1997–2001	2.4 (1980s) 8.2 (1997–2001)		2.3 (1980s) 7.3 (1997–2001)	
Benchimol, et al. 2015 ¹⁶	East Asians, Central Asians, South Asians	Ontario, Canada	Nationwide registration system	1994–2009	4.2 (all) 2.0 (children)		2.7 (all) 2.0 (children)	

creased by 2005 (63.6 cases/10⁵/year and 21.2/10⁵/year, respectively).²¹ In a recent study using the same method as the previous study in 1991, the prevalence rates of UC and CD markedly increased in 2014 (172.9 cases/10⁵/year and 55.6/10⁵/year, respectively).²² Based on information provided on the website for the Japan Intractable Diseases Information Center, 143733 and 170781 patients were diagnosed with UC in 2014 and 2016, respectively. For CD, 36418 and 40855 patients were diagnosed in 2014 and 2016 respectively. Japan has the highest incidence and prevalence rates of IBD in East Asia.

In South Korea, the incidence rate of UC in a particular urban area of Seoul increased over time (0.20 cases/10⁵/year, 1986–1988; 1.23 cases/10⁵/year, 1995–1997; 3.08 cases/10⁵/year, 2001–2005; 5.82 cases/10⁵/year, 2011–2015).^{23–25} The incidence rate of CD in the same district also increased (0.05 cases/10⁵/year, 1986–1990; 1.34 cases/10⁵/year, 2001–2005; 2.44 cases/10⁵/year, 2011–2015).^{23,25} The incidence rates of UC and CD in a nationwide registration system from 2006 to 2014 were reported at 4.6–5.0 cases/10⁵/year and 2.8–3.2 cases/10⁵/year, respectively.^{26,27} The prevalence rates of UC (30.87 cases/10⁵/year, 2005; 41.4 cases/10⁵/year, 2009; 66.0 cases/10⁵/year, 2016) and CD (11.24 cases/10⁵/year, 2005; 16.0 cases/10⁵/year, 2009; 29.6 cases/10⁵/year, 2016) in South Korea were also increasing.^{24,28} The epidemiology of IBD in South Korea is still lower than that in Western countries, but has increased over the past few decades. South Korea has the second highest IBD incidence and prevalence rate in East Asia, and this appears to be strongly associated with improvements in socioeconomic status and accompanying changes in environmental factors.

In Hong-Kong, the incidence rates of UC at a single hospital were reported as 0.34 cases/10⁵/year in 1997 and 0.37 cases/10⁵/year in 2006, indicating no definite increase over time.²⁹ The prevalence rates for UC in the same study were reported at 2.26 cases/10⁵/year in 1997 and 6.3 cases/10⁵/year in 2006. After that study, the incidence rate and prevalence rate of UC were reported at 2.1 cases/10⁵/year in 1997 and 26.5 cases/10⁵/year in 2006, respectively.³⁰ In a recent study of a territory-wide population-based registry, the incidence rate of UC significantly increased with time (0.09 cases/10⁵/year, 1985; 1.51 cases/10⁵/year, 2014).³¹ The prevalence rate of UC also increased (0.49 cases/10⁵/year, 1985; 21.14 cases/10⁵/year, 2014).³¹ The incidence (0.4 cases/10⁵/year, 1990–1992; 1.0 cases/10⁵/year, 1999–2001; 1.46 cases/10⁵/year, 2014) and prevalence (0.49 cases/10⁵/year, 1991; 2.7 cases/10⁵/year, 2006; 14.17 cases/10⁵/year, 2011–2014) of CD increased in the Hong Kong Chinese population.^{31–33} The incidence and prevalence of IBD in Hong Kong are lower than those in the West, but comparable to those in other East Asian countries. In a population-based study performed in 2011, the IBD incidence rate for Mainland China was 0.52–3.44 cases/10⁵/year; that for Hong Kong was 3.06 cases/10⁵/year; and that for Macau was 2.20 cases/10⁵/year.³⁴

In Taiwan, the incidence and prevalence rates of IBD were relatively low, compared to Japan, South Korea, and Hong

Table 2. Incidence and Prevalence of Inflammatory Bowel Diseases in Indigenous Asians

Author	Ethnic group	Study method	Dates	Ulcerative colitis		Crohn's disease	
				Incidence (cases/10 ⁵ person-years)	Prevalence (cases/10 ⁵ persons)	Incidence (cases/10 ⁵ person-years)	Prevalence (cases/10 ⁵ persons)
Higashi, et al. 1988 ¹⁸	Japanese	Nationwide registration system	1985		7.85		1.86
Yoshida and Murate 1990 ¹⁹	Japanese			0.36–0.40			
Morita, et al. 1995 ²⁰	Japanese	Survey of nationwide hospitals	1991	1.95	18.1	0.51	5.9
Asakura, et al. 2009 ²¹	Japanese	Nationwide registration system	2005		63.6		21.2
Murakami, et al. 2019 ²²	Japanese	Survey of nationwide hospitals	2014		172.9		55.6
Okabayashi, et al. 2020 ²⁰	Japanese	Survey of nationwide hospitals	2014	12.2	133.2	2.0	31.9
Yang, et al. 2000 ²³	Koreans	Data from all medical facilities within a well-defined district	1986–1997	0.20 (1986–1988) 1.23 (1995–1997)	7.57 (1997)		
Yang, et al. 2008 ²⁴	Koreans	Data from all medical facilities within a well-defined district	1986–2005	3.08 (2001–2005)	30.87 (2005)	0.05 (1986–1990) 1.34 (2001–2005)	11.24 (2005)
Kim, et al. 2015 ²⁶	Koreans	Nationwide registration system	2006–2012	4.6		3.2	
Jung, et al. 2017 ²⁷	Koreans	Nationwide registration system	2011–2014	5.0		2.8	
Kwak, et al. 2019 ²⁸	Koreans	Nationwide registration system	2010–2016		41.4 (2009) 66.0 (2016)		16.0 (2009) 29.6 (2016)
Park, et al. 2019 ²⁵	Koreans	Data from all medical facilities within a well-defined district	1986–2015	0.29 (1986–1999) 5.82 (2011–2015)	76.66 (2015)	0.06 (1986–1999) 2.44 (2011–2015)	31.59 (2015)
Leong, et al. 2004 ³²	Hong Kong Chinese	Data from a regional hospital in a well-defined catchment area	1990–2001			0.4 (1990–1992) 1.0 (1999–2001)	
Lok, et al. 2007 ³³	Hong Kong Chinese	Data from a regional hospital in a well-defined catchment area	1997–2006	0.34 (1997) 0.37 (2006)	2.26 (1997) 6.3 (2006)		
Lok, et al. 2007 ³³	Hong Kong Chinese	Data from a regional hospital in a well-defined catchment area	1991–2006			0.12 (1991) 0.25 (2006)	0.49 (1991) 2.7 (2006)
Chow, et al. 2009 ³⁰	Hong Kong Chinese	Data from a regional hospital in a well-defined catchment area	1985–2006	2.1 (2006)	26.5 (2006)		
Ng, et al. 2016 ³¹	Hong Kong Chinese	Nationwide registration system	1981–2014	0.09 (1995) 1.51 (2014)	0.49 (1985–1989) 21.14 (2011–2014)	0.01 (1985) 1.46 (2014)	0.05 (1985–1989) 14.17 (2011–2014)
Ng, et al. 2013 ³⁴	Hong Kong	Prospective, population-based study of eight countries across Asia and Australia	2011–2012	1.66		1.31	
	Mainland China			0.42–2.22		0.07–1.22	
	Macau			1.00		1.00	
	Malaysia			0.59		0.24	
	Singapore			0.61		0.40	
Sri Lanka	0.95	0.59					
Thailand	0.28–0.36	0.30–0.35					
Chen, et al. 2013 ³⁶	Taiwan	Nationwide registration system	1998–2008	0.37 (1998) 0.78 (2008)			
Wei, et al. 2013 ³⁵	Taiwan	Nationwide registration system	1998–2008	0.61 (1998)	0.61 (1998)	0.19 (1998)	0.19 (2998)
				0.94 (2008)	7.62 (2008)	0.24 (2008)	1.78 (2008)

Table 2. Incidence and Prevalence of Inflammatory Bowel Diseases in Indigenous Asians (continued)

Author	Ethnic group	Study method	Dates	Ulcerative colitis			Crohn's disease		
				Incidence (cases/10 ⁵ person-years)	Prevalence (cases/10 ⁵ persons)	Incidence (cases/10 ⁵ person-years)	Prevalence (cases/10 ⁵ persons)		
Yen, et al. 2019 ³⁷	Taiwan	Nationwide registration system	2001–2015	0.54 (2001) 0.95 (2015)	2.1 (2001) 12.8 (2015)	0.17 (2001) 0.47 (2015)	0.6 (2001) 3.9 (2015)		
Lee, et al. 2000 ³⁸	Singapore	Hospital-based cohort	1985–1996		6 (Chinese) 7 (Malay) 16.2 (Indian)		4 (Chinese) 2.9 (Malay) 4.9 (Indian)		
Hilimi, et al. 2015 ³⁹	Malaysia	Prospective, population-based study	2011–2013	0.46	6.67	0.20	2.17		
Permpoon, et al. 2019 ⁴¹	Thailand	Hospital-based cohort	2005–2010		32 (Thai) 29 (Oriental) 47 (African) 0 (Hispanic) 140 (South Asian) 206 (Middle Eastern) 174 (Caucasian)		43.1 (Asian) 286.71 (Middle eastern) 278.66 (Caucasian)		
Khosla, et al. 1986 ⁴⁵	Punjab, India	Community survey of a well-defined area	1986		42.8				
Sood, et al. 2003 ⁴⁶	Punjab, India	Community survey of a well-defined area	1999–2000	6.02	44.3				
Abdul-Baki, et al. 2007 ⁵³	Lebanon	Health maintenance organization	2004	4.1	106.2	1.4	53.1		
Al-Ghamdi, et al. 2004 ⁵⁴	Riyadh, Saudi Arabia	Hospital-based cohort	1983–2002			0.32 (1983–1992) 1.66 (1993–2002)			
Mouzan, et al. 2014 ⁵⁵	Saudi Arabia	Regional hospital-based cohort (evaluating all cases within the country)	2003–2012	0.16 (2003–2007) 0.24 (2008–2012)		0.19 (2003–2007) 0.35 (2008–2012)			
Al-Nakib, et al. 1984 ⁵⁶	Kuwait	Regional hospital-based cohort (evaluating all cases within the country)	1977–1982	2.27		0.45			
Al-Shamali, et al. 2003 ⁵⁷	Kuwait	Regional hospital-based cohort (evaluating all cases within the country)	1985–1999	2.8	41.7				
Niv, et al. 1990 ⁵⁸	The Upper Galilee, Israel	Community-based survey	1967–1986	0.88 (1967–1976) 3.79 (1977–1986)	Israeli-born Jews (220.56) Asian-African-born (139.2) European-American-born kibbutz members (78.73)				
Odes, et al. 1987 ⁶⁰	Jewish population, Beer Sheva district, Israel	Community-based survey	1964–1985	5.8					
Odes, et al. 1989 ⁶¹	Jewish population, Southern Israel	Community-based survey	1987	5.4 (1979–1987)	89	2.1 (1979–1987)	30		
Shapira, et al. 1998 ⁶⁴	Kinneret, Israel	Community-based survey	1965–1994	3.5	87 (Jewish) 27 (Arab)				

Table 2. Incidence and Prevalence of Inflammatory Bowel Diseases in Indigenous Asians (continued)

Author	Ethnic group	Study method	Dates	Ulcerative colitis		Crohn's disease	
				Incidence (cases/10 ⁵ person-years)	Prevalence (cases/10 ⁵ persons)	Incidence (cases/10 ⁵ person-years)	Prevalence (cases/10 ⁵ persons)
Niv, et al. 2000 ⁶²	Kibbutz, Israel	Community-based survey	1987–1997			5.0	25.5 (1987) 65.1 (1997)
Niv, et al. 1999 ⁶³	Kibbutz, Israel	Community-based survey	1987–1997	5.04	121.0 (1987) 167.2 (1997)		
Zvidi, et al. 2013 ⁶⁵	Kibbutz, Israel	Community-based survey				5.2	112.99 (2007)
Zvidi, et al. 2019 ⁶⁶	Arab residents, Israel	Community-based survey	2009		22		32
Zvidi, et al. 2013 ⁶⁵	Israel	health maintenance organization	2003–2008	16.4 (2003, Jews) 4.1 (2003, Arabs) 9.5 (2008, Jews) 5.0 (2008, Arabs)	127.8 (2003, Jews) 27.1 (2003, Arabs) 192.3 (2008, Jews) 47.8 (2008, Arabs)	14.3 (2003, Jews) 3.1 (2003, Arabs) 11.7 (2008, Jews) 10.6 (2008, Arabs)	108.0 (2003, Jews) 22.6 (2003, Arabs) 177.0 (2008, Jews) 55.9 (2008, Arabs)
Zahedi, et al. 2014 ⁶⁷	Southeast Iran	Community-based survey	2000–2001	4.98		0.8	
Mansour-Ghanaei, et al. 2015 ⁶⁸	North Iran	Regional hospital-based cohort (evaluating all cases within the country)	2002–2012	2.82 (2009) 5.32 (2012)		0.16 (2009) 0.88 (2012)	
Malekzadeh, et al. 2016 ⁶⁹	Iran	Systemic review	1990–2012	2.70 (2012)	35.52 (2012)	0.41 (2012)	5.03 (2012)

Kong.^{35,36} The incidence (0.97 cases/10⁵/year, 2001–2005; 1.16 cases/10⁵/year, 2006–2010; 1.18 cases/10⁵/year, 2011–2015) and prevalence rates (4.54 cases/10⁵/year, 2001–2005; 9.39 cases/10⁵/year, 2006–2010; 14.40 cases/10⁵/year, 2011–2015) of UC in Taiwan increased steadily from 2001 to 2015.³⁷ The incidence (0.18 cases/10⁵/year, 2001–2005; 0.22 cases/10⁵/year, 2006–2010; 0.39 cases/10⁵/year, 2011–2015) and prevalence rates (0.84 cases/10⁵/year, 2001–2005; 1.71 cases/10⁵/year, 2006–2010; 3.04 cases/10⁵/year, 2011–2015) of CD in Taiwan also increased steadily from 2001 to 2015.³⁷

In Singapore, the majority residents were Chinese (78.7%) in 1990; 12.8% were Malays; and 7.6% were Indians. The prevalence rates of UC and CD in Singapore between 1985 and 1996 were 6.0 cases/10⁵/year and 3.6 cases/10⁵/year, respectively.³⁸ Indians had a 2.9-fold higher risk of UC than Chinese in this study, which further implicated ethnic differences in IBD development.

In the Asia-Pacific Crohn's Colitis Epidemiology Study in 2011, the incidence of UC and CD in Malaysia was 0.59 cases/10⁵/year and 0.24 cases/10⁵/year, respectively.³⁴ In Malaysia, the majority of residents of Kinta Valley from 2011 to 2013 were Chinese (43%); 39% were Malays; and 14% were Indians. The incidence of UC and CD in Malaysia between 2011 and 2013 was 0.46 cases/10⁵/year and 0.2 cases/10⁵/year, respectively.³⁹ The prevalence of UC and CD in Malaysia between 2011 and 2013 was 6.67 cases/10⁵/year and 2.17 cases/10⁵/year, respectively.³⁹ Both incidence and prevalence rates in Indians were higher than those in Chinese and Malays. Although, the incidence and prevalence rates of IBD are low in Malaysia, they have increased over the past two decades.

In Thailand, the incidence of UC and CD was reported at 0.35–0.36 cases/10⁵/year and 0.28–0.30 cases/10⁵/year in the Asia-Pacific Crohn's Colitis Epidemiology Study in 2011. The prevalence of UC and CD in a single institution of Bangkok, Thailand during 2005–2010 was significantly lower in Asian individuals than Middle Eastern and Caucasian individuals.^{40,41}

In summary, the incidence and prevalence rates of IBD in East Asia are lower than those in Western countries, but have steadily increased over time. A north-south gradient, with an increasing trend reported in Northern countries, compared to Southern countries in Europe, could be a global phenomenon.^{42,43} Environmental factors, such high temperature, latitude, and precipitation, could change microbial compositions and affect the development of IBD.⁴⁴ There is a hypothesis that summer temperature could be associated with a protective effect against IBD by affecting the richness of microbiome.⁴⁴ In addition to climate, various other factors, such as dietary habits and socioeconomic status, have also been shown to be associated with the incidence and prevalence of IBD. The epidemiologic studies in Asia, especially in East Asia, have several limitations, mainly due to their hospital-based approach. In addition, some studies were based on small regions. Accordingly, further comprehensive and accurate studies are warranted in

East Asian countries.

South Asia

South Asia is comprised of India, Pakistan, Bangladesh, Nepal, and Sri Lanka. There are only two available studies on the incidence and prevalence of IBD in this region, and these were performed in Northern India, not across the whole country. The prevalence rate of UC in Northern India in 1986 was 42.8 cases/10⁵/year.⁴⁵ The prevalence rate of UC in Northern India in 1999 was 44.3 cases/10⁵/year, and the incidence rate was 6.02 cases/10⁵/year.⁴⁶ The incidence and prevalence of UC in India are highest among Asia countries, although they are much lower than those in Western countries.^{47,48} Although there was no study on the incidence and prevalence of CD in India, indirect estimates of CD burden have risen over the years.^{49,50} Recently, Kedia and Ahuja⁵¹ predicted that the overall disease burden was highest in India among six countries in Asia, North America, and Europe. Infectious diseases, including intestinal tuberculosis, remain endemic in India, and there are many other infectious mimics of IBD that can lead to misdiagnosis and diagnostic delay in India.⁴⁹ However, there are many efforts to improve awareness about IBD and to improve access to medical services to differentiate acute infectious colitis from IBD.⁵² Nevertheless, more than 300000 Indians are esti-

mated to have CD, and 1.1 million people have UC in India. Because of the large population of India, with more than 120 million, the total IBD burden of India could be highest in the world. Because research in South Asia is very scarce, epidemiologic studies are needed. Since Indians are ethnically included as Europeans, similar incidence and prevalence rates could be possible; however, it seems that incidence and prevalence rates are still lower due to differences in climate, hygiene, and food intake.

West Asia

In Lebanon, the incidence rates of UC and CD were reported at 4.1 cases/10⁵/year and 1.4 cases/10⁵/year, respectively, on a cohort based on university-based healthy program from 2000 to 2004.⁵³ In Saudi Arabia, the incidence of CD at a university hospital in Riyadh increased gradually through the 1980s (0.32 cases/10⁵/year) and 1990s (1.66 cases/10⁵/year).⁵⁴ In a multi-center study of Saudi Arabian children, the incidence rate of UC increased gradually from 2003–2007 (0.16 cases/10⁵/year) to 2008–2012 (0.24 cases/10⁵/year).⁵⁵ The incidence of CD also increased from 2003–2007 (0.19 cases/10⁵/year) to 2008–2012 (0.35 cases/10⁵/year).⁵⁵ In Kuwait, the incidence of UC and CD were reported to be 2.27 cases/10⁵/year and 0.45 cases/10⁵/year, respectively, from 1977–1982.⁵⁶ The incidence of UC in

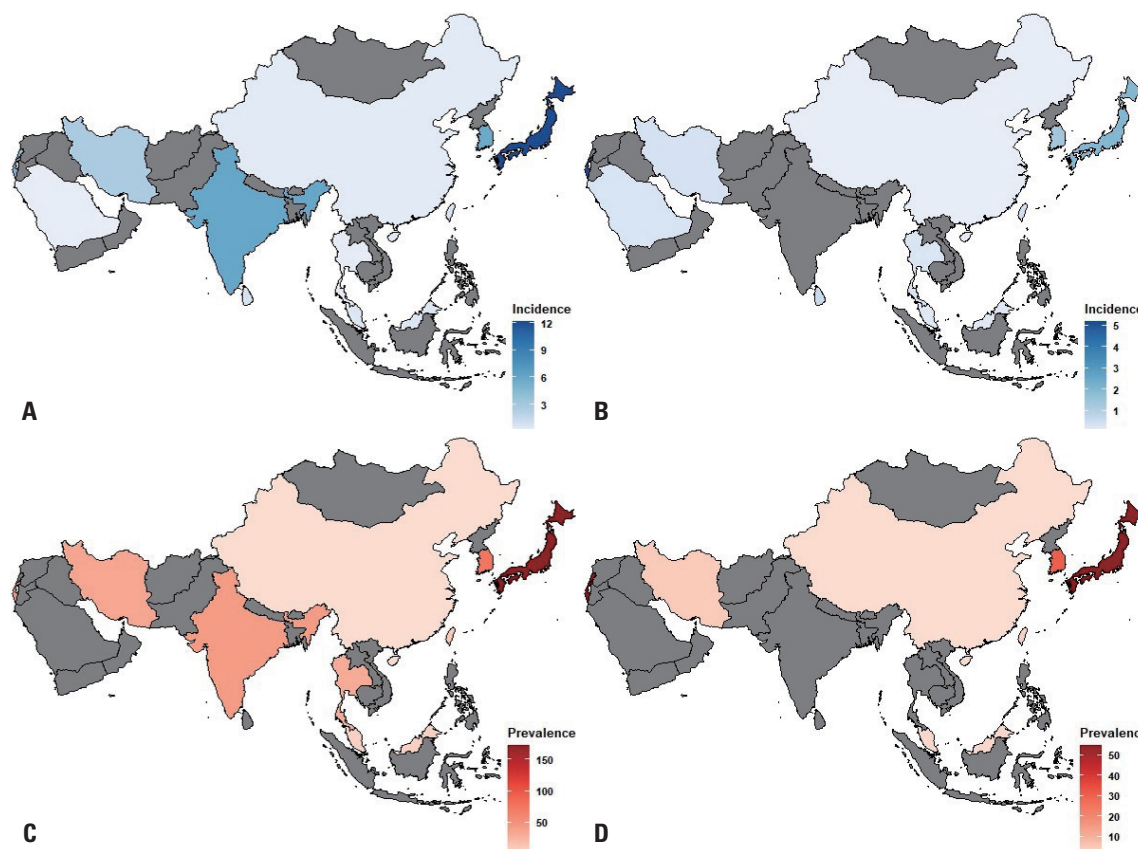


Fig. 1. Incidence and prevalence rate of inflammatory bowel disease in Asian countries. (A) Incidence rate (per 100000 population) and (B) prevalence rate (per 100000 population) of ulcerative colitis in the 21st century. (C) Incidence rate (per 100000 population) and (D) prevalence rate (per 100000 population) of Crohn's disease in the 21st century. The gray zone reflects the absence of data.

Kuwait increased from 1985 to 1990 (2.8 cases/10⁵/year).⁵⁷ In Oman, the incidence rate of UC was 1.35 cases/10⁵/year in 1980s.⁵⁸ In summary, the incidence and prevalence of IBD in Arab countries appear to be relatively low, although there is an increasing trend.

In Israel, the incidence of UC and CD in the Jewish population was reported at 3.79–5.8 cases/10⁵/year and 2.1–5.2 cases/10⁵/year, respectively, in the 1980s and 1990s.^{59–64} The incidence and prevalence of IBD in the Jewish population also increased in Israel.^{59,62,63} Interestingly, the prevalence of IBD in the Israel Arab population, who represent 20% of the total population, was lower than that in the Israel Jewish population.^{59,65} The incidence and prevalence of IBD in an Arab population were lower than those in an Jewish population from 2003 to 2008, although there has been a rapid increase in CD in the Arab population.⁶⁶ Also, the incidence and prevalence of IBD in the Arab population in Israel are relatively higher than those in other Arab countries.⁶⁶ Various environmental factors, ethnic factors, and microbial factors might affect these epidemiologic shifts in these areas.

In Iran, the incidence of UC and CD were reported at 2.70–5.32 cases/10⁵/year and 0.16–0.88 cases/10⁵/year, respectively, in 1990–2012.^{67–69} An epidemiologic study in Iran, a rapidly developing Middle Eastern country, demonstrated a rapid increase in IBD in parallel with other developing countries. From an ethnic point of view, West Asian populations are similar to the European population, compared to East Asian populations. Therefore, the incidence and prevalence in West Asia could increase in the future.

In summary, the incidence and prevalence of IBD in East, South, and West Asia remain lower than those in Western countries, including America, Europe, and Australia. Nevertheless, the overall incidence and prevalence of IBD have consistently increased. Among Asian countries, India has had a higher incidence rate than other countries. The incidence and prevalence of IBD in Asia countries during the 21st century stratified from low to high (per 1000000) are presented in Fig. 1. Immigrant studies support the role of environmental factors in IBD development. Also, studies comparing various population groups support the contribution of ethnic factors to the development of IBD. From epidemiologic studies, we could deduce that various factors, including geographic factors, ethnic factors, and environmental factors, may be simultaneously associated with the pathogenesis of IBD.

CONCLUSIONS

Epidemiologic studies of IBD have been conducted in Asian countries, and the incidence and prevalence of IBD in Asia have increased over time. Asia, as a continent, has the most IBD patients in the world, and the observed increase in IBD among Asian countries is likely associated with environmental factors

related to IBD pathogenesis, since genetic factors would not change over only a few decades. Studying the epidemiology of IBD in Asia may unravel the etiopathogenesis and risk factors for IBD. Also, research into genetic susceptibility and ethnic differences may provide insights into possible genetic etiological factors for IBD. Continued research and collection of incidence and prevalence data are warranted. Also, a large scale study through which Asian countries collaborate together to conduct comprehensive epidemiological and genetic studies could prove beneficial.

AUTHOR CONTRIBUTIONS

Conceptualization: Jae Hee Cheon. **Data curation:** Jihye Park. **Supervision:** Jae Hee Cheon. **Visualization:** Jihye Park. **Writing—original draft:** Jihye Park. **Writing—review & editing:** Jae Hee Cheon. **Approval of final manuscript:** all authors.

ORCID iDs

Jihye Park <https://orcid.org/0000-0002-5836-8735>
Jae Hee Cheon <https://orcid.org/0000-0002-2282-8904>

REFERENCES

1. Ng SC, Shi HY, Hamidi N, Underwood FE, Tang W, Benchimol EI, et al. Worldwide incidence and prevalence of inflammatory bowel disease in the 21st century: a systematic review of population-based studies. *Lancet* 2018;390:2769-78.
2. Yang Y, Owyang C, Wu GD. East meets West: the increasing incidence of inflammatory bowel disease in Asia as a paradigm for environmental effects on the pathogenesis of immune-mediated disease. *Gastroenterology* 2016;151:e1-5.
3. Singh P, Ananthakrishnan A, Ahuja V. Pivot to Asia: inflammatory bowel disease burden. *Intest Res* 2017;15:138-41.
4. Ng SC, Kaplan GG, Tang W, Banerjee R, Adigopula B, Underwood FE, et al. Population density and risk of inflammatory bowel disease: a prospective population-based study in 13 countries or regions in Asia-Pacific. *Am J Gastroenterol* 2019;114:107-15.
5. Mak WY, Zhao M, Ng SC, Burisch J. The epidemiology of inflammatory bowel disease: east meets west. *J Gastroenterol Hepatol* 2020;35:380-9.
6. Han M, Jung YS, Cheon JH, Park S. Comparison of real-world outcomes of infliximab versus adalimumab in biologic-naïve Korean patients with ulcerative colitis: a population-based study. *Yonsei Med J* 2020;61:48-55.
7. Knights D, Lassen KG, Xavier RJ. Advances in inflammatory bowel disease pathogenesis: linking host genetics and the microbiome. *Gut* 2013;62:1505-10.
8. Jayanthi V, Probert CS, Pollock DJ, Baithun SI, Rampton DS, Mayberry JF. Low incidence of ulcerative colitis and proctitis in Bangladeshi migrants in Britain. *Digestion* 1992;52:34-42.
9. Tsironi E, Feakins RM, Probert CS, Rampton DS, Phil D. Incidence of inflammatory bowel disease is rising and abdominal tuberculosis is falling in Bangladeshis in East London, United Kingdom. *Am J Gastroenterol* 2004;99:1749-55.
10. Probert CS, Jayanthi V, Pollock DJ, Baithun SI, Mayberry JF, Rampton DS. Crohn's disease in Bangladeshis and Europeans in Britain: an epidemiological comparison in Tower Hamlets. *Postgrad Med*

- J 1992;68:914-20.
11. Carr I, Mayberry JF. The effects of migration on ulcerative colitis: a three-year prospective study among Europeans and first- and second-generation South Asians in Leicester (1991-1994). *Am J Gastroenterol* 1999;94:2918-22.
 12. Probert CS, Jayanthi V, Hughes AO, Thompson JR, Wicks AC, Mayberry JF. Prevalence and family risk of ulcerative colitis and Crohn's disease: an epidemiological study among Europeans and south Asians in Leicestershire. *Gut* 1993;34:1547-51.
 13. Juyal G, Negi S, Sood A, Gupta A, Prasad P, Senapati S, et al. Genome-wide association scan in north Indians reveals three novel HLA-independent risk loci for ulcerative colitis. *Gut* 2015;64:571-9.
 14. Misra R, Limdi J, Cooney R, Sakuma S, Brookes M, Fogden E, et al. Ethnic differences in inflammatory bowel disease: results from the United Kingdom inception cohort epidemiology study. *World J Gastroenterol* 2019;25:6145-57.
 15. Beaugerie L, Langholz E, Nyboe-Andersen N, Pigneur B, Sokol H; ECCO Epicom. Differences in epidemiological features between ulcerative colitis and Crohn's disease: the early life-programmed versus late dysbiosis hypothesis. *Med Hypotheses* 2018;115:19-21.
 16. Benchimol EI, Mack DR, Guttman A, Nguyen GC, To T, Mojavehian N, et al. Inflammatory bowel disease in immigrants to Canada and their children: a population-based cohort study. *Am J Gastroenterol* 2015;110:553-63.
 17. Vangay P, Johnson AJ, Ward TL, Al-Ghalith GA, Shields-Cutler RR, Hillmann BM, et al. US immigration westernizes the human gut microbiome. *Cell* 2018;175:962-72.e10.
 18. Higashi A, Watanabe Y, Ozasa K, Hayashi K, Aoike A, Kawai K. Prevalence and mortality of ulcerative colitis and Crohn's disease in Japan. *Gastroenterol Jpn* 1988;23:521-6.
 19. Yoshida Y, Murata Y. Inflammatory bowel disease in Japan: studies of epidemiology and etiopathogenesis. *Med Clin North Am* 1990;74:67-90.
 20. Morita N, Toki S, Hirohashi T, Minoda T, Ogawa K, Kono S, et al. Incidence and prevalence of inflammatory bowel disease in Japan: nationwide epidemiological survey during the year 1991. *J Gastroenterol* 1995;30 Suppl 8:1-4.
 21. Asakura K, Nishiwaki Y, Inoue N, Hibi T, Watanabe M, Takebayashi T. Prevalence of ulcerative colitis and Crohn's disease in Japan. *J Gastroenterol* 2009;44:659-65.
 22. Murakami Y, Nishiwaki Y, Oba MS, Asakura K, Ohfuji S, Fukushima W, et al. Estimated prevalence of ulcerative colitis and Crohn's disease in Japan in 2014: an analysis of a nationwide survey. *J Gastroenterol* 2019;54:1070-7.
 23. Yang SK, Hong WS, Min YI, Kim HY, Yoo JY, Rhee PL, et al. Incidence and prevalence of ulcerative colitis in the Songpa-Kangdong District, Seoul, Korea, 1986-1997. *J Gastroenterol Hepatol* 2000;15:1037-42.
 24. Yang SK, Yun S, Kim JH, Park JY, Kim HY, Kim YH, et al. Epidemiology of inflammatory bowel disease in the Songpa-Kangdong district, Seoul, Korea, 1986-2005: a KASID study. *Inflamm Bowel Dis* 2008;14:542-9.
 25. Park SH, Kim YJ, Rhee KH, Kim YH, Hong SN, Kim KH, et al. A 30-year trend analysis in the epidemiology of inflammatory bowel disease in the Songpa-Kangdong District of Seoul, Korea in 1986-2015. *J Crohns Colitis* 2019;13:1410-7.
 26. Kim HJ, Hann HJ, Hong SN, Kim KH, Ahn IM, Song JY, et al. Incidence and natural course of inflammatory bowel disease in Korea, 2006-2012: a nationwide population-based study. *Inflamm Bowel Dis* 2015;21:623-30.
 27. Jung YS, Han M, Kim WH, Park S, Cheon JH. Incidence and clinical outcomes of inflammatory bowel disease in South Korea, 2011-2014: a nationwide population-based study. *Dig Dis Sci* 2017;62:2102-12.
 28. Kwak MS, Cha JM, Lee HH, Choi YS, Seo SI, Ko KJ, et al. Emerging trends of inflammatory bowel disease in South Korea: a nationwide population-based study. *J Gastroenterol Hepatol* 2019;34:1018-26.
 29. Lok KH, Hung HG, Ng CH, Kwong KC, Yip WM, Lau SF, et al. Epidemiology and clinical characteristics of ulcerative colitis in Chinese population: experience from a single center in Hong Kong. *J Gastroenterol Hepatol* 2008;23:406-10.
 30. Chow DK, Leong RW, Tsoi KK, Ng SS, Leung WK, Wu JC, et al. Long-term follow-up of ulcerative colitis in the Chinese population. *Am J Gastroenterol* 2009;104:647-54.
 31. Ng SC, Leung WK, Shi HY, Li MK, Leung CM, Ng CK, et al. Epidemiology of inflammatory bowel disease from 1981 to 2014: results from a territory-wide population-based registry in Hong Kong. *Inflamm Bowel Dis* 2016;22:1954-60.
 32. Leong RW, Lau JY, Sung JJ. The epidemiology and phenotype of Crohn's disease in the Chinese population. *Inflamm Bowel Dis* 2004;10:646-51.
 33. Lok KH, Hung HG, Ng CH, Li KK, Li KF, Szeto ML. The epidemiology and clinical characteristics of Crohn's disease in the Hong Kong Chinese population: experiences from a regional hospital. *Hong Kong Med J* 2007;13:436-41.
 34. Ng SC, Tang W, Ching JY, Wong M, Chow CM, Hui AJ, et al. Incidence and phenotype of inflammatory bowel disease based on results from the Asia-pacific Crohn's and colitis epidemiology study. *Gastroenterology* 2013;145:158-65.e2.
 35. Wei SC, Lin MH, Tung CC, Weng MT, Kuo JS, Shieh MJ, et al. A nationwide population-based study of the inflammatory bowel diseases between 1998 and 2008 in Taiwan. *BMC Gastroenterol* 2013;13:166.
 36. Chen CY, Lee KT, Charles Tzu-Chi L, Lai WT, Huang YB. Epidemiology and disease burden of ulcerative colitis in Taiwan: a nationwide population-based study. *Value Health Reg Issues* 2013;2:127-34.
 37. Yen HH, Weng MT, Tung CC, Wang YT, Chang YT, Chang CH, et al. Epidemiological trend in inflammatory bowel disease in Taiwan from 2001 to 2015: a nationwide populationbased study. *Intest Res* 2019;17:54-62.
 38. Lee YM, Fock K, See SJ, Ng TM, Khor C, Teo EK. Racial differences in the prevalence of ulcerative colitis and Crohn's disease in Singapore. *J Gastroenterol Hepatol* 2000;15:622-5.
 39. Hilmi I, Jaya F, Chua A, Heng WC, Singh H, Goh KL. A first study on the incidence and prevalence of IBD in Malaysia--results from the Kinta Valley IBD Epidemiology Study. *J Crohns Colitis* 2015;9:404-9.
 40. Permpoon V, Pongpirul K, Anuras S. Ethnic variations in ulcerative colitis: experience of an international hospital in Thailand. *World J Gastrointest Pharmacol Ther* 2016;7:428-33.
 41. Permpoon V, Pongpirul K, Anuras S. Five-year clinical outcomes of Crohn's disease: a report of 287 multiethnic cases from an International Hospital in Thailand. *Clin Exp Gastroenterol* 2019;12:203-8.
 42. Schultz M, Butt AG. Is the north to south gradient in inflammatory bowel disease a global phenomenon? *Expert Rev Gastroenterol Hepatol* 2012;6:445-7.
 43. Economou M, Pappas G. New global map of Crohn's disease: genetic, environmental, and socioeconomic correlations. *Inflamm Bowel Dis* 2008;14:709-20.
 44. Aamodt G, Bengtson MB, Vatn MH. Can temperature explain the latitudinal gradient of ulcerative colitis? Cohort of Norway. *BMC Public Health* 2013;13:530.
 45. Khosla SN, Girdhar NK, Lal S, Mishra DS. Epidemiology of ulcerative colitis in hospital and select general population of northern India. *J Assoc Physicians India* 1986;34:405-7.

46. Sood A, Midha V, Sood N, Bhatia AS, Avasthi G. Incidence and prevalence of ulcerative colitis in Punjab, North India. *Gut* 2003; 52:1587-90.
47. Loftus CG, Loftus EV Jr, Harmsen WS, Zinsmeister AR, Tremaine WJ, Melton LJ 3rd, et al. Update on the incidence and prevalence of Crohn's disease and ulcerative colitis in Olmsted County, Minnesota, 1940-2000. *Inflamm Bowel Dis* 2007;13:254-61.
48. Sjöberg D, Holmström T, Larsson M, Nielsen AL, Holmquist L, Ek-bom A, et al. Incidence and natural history of ulcerative colitis in the Uppsala Region of Sweden 2005-2009 - results from the IBD cohort of the Uppsala Region (ICURE). *J Crohns Colitis* 2013;7:e351-7.
49. Das K, Ghoshal UC, Dhali GK, Benjamin J, Ahuja V, Makharia GK. Crohn's disease in India: a multicenter study from a country where tuberculosis is endemic. *Dig Dis Sci* 2009;54:1099-107.
50. Sood A, Singh A, Sudhakar R, Midha V, Mahajan R, Mehta V, et al. Exclusive enteral nutrition for induction of remission in anti-tumor necrosis factor refractory adult Crohn's disease: the Indian experience. *Intest Res* 2020;18:184-91.
51. Kedia S, Ahuja V. Epidemiology of inflammatory bowel disease in India: the great shift east. *Inflamm Intest Dis* 2017;2:102-15.
52. Lin WC, Chang CW, Chen MJ, Chu CH, Shih SC, Hsu TC, et al. Challenges in the diagnosis of ulcerative colitis with concomitant bacterial infections and chronic infectious colitis. *PLoS One* 2017; 12:e0189377.
53. Abdul-Baki H, ElHajj I, El-Zahabi LM, Azar C, Aoun E, Zantout H, et al. Clinical epidemiology of inflammatory bowel disease in Lebanon. *Inflamm Bowel Dis* 2007;13:475-80.
54. Al-Ghamdi AS, Al-Mofleh IA, Al-Rashed RS, Al-Amri SM, Aljebreen AM, Isnani AC, et al. Epidemiology and outcome of Crohn's disease in a teaching hospital in Riyadh. *World J Gastroenterol* 2004; 10:1341-4.
55. El Mouzan MI, Saadah O, Al-Saleem K, Al Edreesi M, Hasosah M, Alanazi A, et al. Incidence of pediatric inflammatory bowel disease in Saudi Arabia: a multicenter national study. *Inflamm Bowel Dis* 2014;20:1085-90.
56. Al-Nakib B, Radhakrishnan S, Jacob GS, Al-Liddawi H, Al-Ruwaih A. Inflammatory bowel disease in Kuwait. *Am J Gastroenterol* 1984;79:191-4.
57. Al-Shamali MA, Kalaoui M, Patty I, Hasan F, Khajah A, Al-Nakib B. Ulcerative colitis in Kuwait: a review of 90 cases. *Digestion* 2003; 67:218-24.
58. Radhakrishnan S, Zubaidi G, Daniel M, Sachdev GK, Mohan AN. Ulcerative colitis in Oman. A prospective study of the incidence and disease pattern from 1987 to 1994. *Digestion* 1997;58:266-70.
59. Niv Y, Torten D, Tamir A, Epstein L. Incidence and prevalence of ulcerative colitis in the upper Galilee, Northern Israel, 1967-1986. *Am J Gastroenterol* 1990;85:1580-3.
60. Odes HS, Fraser D, Krawiec J. Incidence of idiopathic ulcerative colitis in Jewish population subgroups in the Beer Sheva region of Israel. *Am J Gastroenterol* 1987;82:854-8.
61. Odes HS, Fraser D, Krawiec J. Inflammatory bowel disease in migrant and native Jewish populations of southern Israel. *Scand J Gastroenterol Suppl* 1989;170:36-7.
62. Niv Y, Abuksis G, Fraser GM. Epidemiology of ulcerative colitis in Israel: a survey of Israeli kibbutz settlements. *Am J Gastroenterol* 2000;95:693-8.
63. Niv Y, Abuksis G, Fraser GM. Epidemiology of Crohn's disease in Israel: a survey of Israeli kibbutz settlements. *Am J Gastroenterol* 1999;94:2961-5.
64. Shapira M, Tamir A. Ulcerative colitis in the Kinneret sub district, Israel 1965-1994: incidence and prevalence in different subgroups. *J Clin Gastroenterol* 1998;27:134-7.
65. Zvidi I, Fraser GM, Niv Y, Birkenfeld S. The prevalence of inflammatory bowel disease in an Israeli Arab population. *J Crohns Colitis* 2013;7:e159-63.
66. Zvidi I, Boltin D, Niv Y, Dickman R, Fraser G, Birkenfeld S. The incidence and prevalence of inflammatory bowel disease in the Jewish and Arab populations of Israel. *Isr Med Assoc J* 2019;21:194-7.
67. Zahedi MJ, Darvish Moghadam S, Hayat Bakhsh Abbasi M, Dehghani M, Shafiei Pour S, Zydabady Nejad H, et al. The incidence rate of inflammatory bowel disease in an urban area of Iran: a developing country. *Middle East J Dig Dis* 2014;6:32-6.
68. Mansour-Ghanaei F, Haghkerdar M, Joukar F, Aminian K, Yousefi Mashhour M, Shafaghi A, et al. Features of inflammatory bowel disease in Guilan province, North of Iran, during 2002-2012. *Middle East J Dig Dis* 2015;7:69-74.
69. Malekzadeh MM, Vahedi H, Gohari K, Mehdipour P, Sepanlou SG, Ebrahimi Daryani N, et al. Emerging epidemic of inflammatory bowel disease in a middle income country: a nation-wide study from Iran. *Arch Iran Med* 2016;19:2-15.
70. Okabayashi S, Kobayashi T, Hibi T. Inflammatory bowel disease in Japan-is it similar to or different from Westerns? *J Anus Rectum Colon* 2020;4:1-13.