

Characterizing Sleep and Physical Activity Patterns Among Adults in Puerto Rico with Inflammatory Bowel Disease

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Objective: Physical inactivity and sleep disturbances can affect health and quality of life in people with inflammatory bowel disease (IBD). This study aimed to describe physical activity (PA) and sleep characteristics in adults with IBD in Puerto Rico.

Methods: Forty-eight participants (24 women, 24 men; mean age, 42.1 ± 14.1 years), 73% with Crohn's disease (CD) and 27% with ulcerative colitis (UC), completed anthropometric measures and wore an accelerometer on the non-dominant wrist for 7 days to assess PA and sleep characteristics. The Pittsburgh Sleep Quality Index and the Inflammatory Bowel Disease Questionnaire were also used in a subsample ($n = 43$).

Results: On average, patients with IBD met PA recommendations (≥ 150 min/week) but had short sleep duration. Patients with CD were significantly younger than patients with UC, but no differences were found in PA, body mass index (BMI), or sleep duration. Men were taller and heavier than women, but BMI, PA, and sleep characteristics were similar, except that men had more sleep interruptions. Physical activity peaked in the afternoon and evening. No significant correlations were found between PA and sleep quality. However, sleep duration was inversely correlated with BMI, and PA was positively correlated with BMI.

Conclusion: Patients with IBD were generally overweight and physically active and had short sleep duration. Monitoring PA, sleep, and BMI may inform targeted health interventions in this population.

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Key words: Accelerometer, Sleep duration, Sleep quality, Crohn's disease, Ulcerative colitis

Inflammatory bowel disease (IBD) is a debilitating and chronic inflammatory disorder of the gastrointestinal tract influenced by genetic and environmental factors. The main types are Crohn's disease (CD) and ulcerative colitis (UC). In 2019, approximately 4.9 million cases of IBD were identified worldwide, with the highest rates being reported in China and the United States: 66.9 and 245.3 cases per 100,000 people, respectively (1). An estimate of IBD incidence in Southwest Puerto Rico (2) showed an increase from 1996 to 2000 ($3.07/100,000$ vs. $7.74/100,000$; $P < .001$), with a higher incidence for CD than for UC. In 2013, the overall IBD prevalence in Puerto Rico was $181.54/100,000$, with a higher prevalence of UC in women and of CD in men (3). Direct health care costs associated with ambulatory visits, hospitalizations, and medications have been estimated at \$9,000 to \$12,000 per patient annually (4).

Emerging evidence suggests a potential interaction between skeletal muscle, adipose tissue, and intestinal inflammation, with leisure-time physical activity (PA) playing a role in modulating the gut microbiome (5). Physical activity may reduce inflammation by decreasing visceral fat and inhibiting pro-inflammatory cytokines, with effects varying by intensity, duration, and type (6). Moreover, regular PA, including walking, yoga, muscle strengthening, and mind-body therapies, can help manage obesity and its associated symptoms—anxiety, depression, fatigue, and pain—commonly observed in patients with IBD (6). Physical activity can also help reduce the sleep disturbances that affect 47–82% of patients with

IBD, particularly women and patients with CD (6, 7). Brederp et al. (8) reported that patients with IBD in a category of stable low fatigue symptoms were more likely to report fewer sleep problems and regular daily PA. For patients with mild to moderately active IBD, at least 30 minutes per day of moderate-intensity endurance and resistance exercise 3 times per week has been recommended (9). However, current PA guidelines for health recommend 150–300 min/week of moderate-to-vigorous physical activity (MVPA) (10). Despite these guidelines and the established benefits of PA, many patients remain inactive and unaware of its importance (11,12). However, Fragan, Osborne, and Schults (13) found that 66% of their patients with IBD met PA guidelines, with a preference for low-impact activity, such as walking.

Currently, sleep and PA patterns among adults with IBD in Puerto Rico are not well characterized. This study aimed to examine these patterns among patients with IBD in Puerto Rico and to explore associations between PA, sleep characteristics, quality of sleep, and quality of life.

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Materials and Methods

A total of 48 adult patients (24 women, 24 men) with confirmed IBD (35 CD, 13 UC) in clinical remission were recruited during scheduled visits to the gastroenterology clinic at the University of Puerto Rico, Medical Sciences Campus and provided written informed consent under a protocol previously approved by the Institutional Review Board of the University of Puerto Rico, Medical Sciences Campus. Exclusion criteria included recent hospitalization (within 2 months), limited or no mobility, and pregnancy.

Height and weight were measured using a Seca stadiometer (North America, CA, USA), and a Tanita digital scale (Tokyo, Japan), and used to calculate body mass index (BMI, kg/m²). Participants wore a wGT3X-BT accelerometer (Ametris - formerly ActiGraph LLC., Pensacola, FL) on the non-dominant wrist for 24 hours/day over 7 consecutive days to assess PA and sleep characteristics. The devices were configured to record at 60 Hz, and data were analyzed in 60-second epochs. To identify PA intensity, body accelerations caused by physical movement are registered as activity counts per minute: less than 200 represent sedentary behavior, 200–2020 represent light activity, 2020–5999 represent moderate intensity, and more than 6000 represent vigorous intensity (14). Sleep parameters were derived using the Cole-Kripke algorithm (15). Sleep quality was further assessed using the Pittsburgh Sleep Quality Index (PSQI), with scores at or above 5 indicating poor sleep. Quality of life was evaluated in a subsample (women = 23, men = 20) using the Inflammatory Bowel Disease Questionnaire (IBDQ), in which scores less than 209 indicate poor quality of life.

Statistical analyses, including Kruskal–Wallis and Wilcoxon Mann–Whitney U tests to assess differences by sex and by IBD subtype (CD vs. UC), and Spearman correlations to evaluate associations between anthropometric, PA, and sleep variables, were conducted using STATA 15.1 (StataCorp LLC, College Station, TX, USA). Statistical significance was set at a less than 0.05.

Results

Table 1 presents means and standard deviations for all study variables in 48 participants stratified by sex (24 women, 24 men). The average age was 42.1 years (range: 21–79). Men were significantly taller and heavier than women; however, no sex differences were observed in BMI, sedentary time, PA (light, moderate, or moderate-to-vigorous), daily steps, or sleep duration. The BMI distribution was as

follows: 40% normal weight (BMI <25 kg/m²), 38% overweight (BMI 25–29.9 kg/m²), and 23% obese (BMI ≥ 30 kg/m²). Men experienced more night awakenings than women did. Participants with UC were older than those with CD, but did not differ in sex distribution (CD: 46% women, 54% men; UC: 62% women, 38% men; $P = .330$), BMI, sedentary time, PA, or sleep metrics (data not shown).

Participants engaged only in light and moderate PA; no vigorous PA was recorded, regardless of sex and IBD diagnosis. However, according to current PA guidelines, the participants' engagement in moderate intensity PA was enough (≥150 min/week) for them to be considered physically active (10). All PSQI scores exceeded the threshold of 5, indicating poor sleep quality. Similarly, all IBDQ scores were lower than 209, suggesting poor quality of life.

Body mass index was positively correlated with MVPA ($\rho = 0.32$, $P = .03$), indicating higher MVPA among overweight and obese participants (normal weight = 126.1 ± 53.0 , overweight = 194.2 ± 82.5 , and obese = 171.9 ± 77.4 min/day; $P = .02$). No significant correlations were found between MVPA and PSQI sleep quality

Table 1. Characteristics of adults with Inflammatory bowel disease by sex: demographics, anthropometrics, physical activity, and sleep

Variable	All (n = 48)	Women (n = 24)	Men (n = 24)	P value
Age (years)	42.1 ± 14.1 (21–79)	44.5 ± 16.7	39.8 ± 10.9	.245
Height (cm)	167.6 ± 8.8 (143.2–188.9)	162.1 ± 6.3	173.1 ± 7.5	<.001
Weight (kg)	74.1 ± 17.9 (34.4–118.2)	68.2 ± 17.4	80.1 ± 16.7	.019
BMI (kg/m ²)	26.2 ± 5.3 (16.7–38.2)	25.8 ± 6.0	26.7 ± 4.7	.581
Sedentary (h/day)	6.7 ± 1.8 (2.8–10.4)	6.7 ± 1.8	6.7 ± 1.9	.898
Light PA (h/day)	8.6 ± 1.4 (5.8–11.1)	8.5 ± 1.2	8.6 ± 1.5	.762
Moderate PA (min/day)	162.2 ± 75.8 (330–2616)	159.8 ± 60.6	164.6 ± 89.8	.829
MVPA (min/week)	1,143.2 ± 526.9 (330–2,616)	1,132.4 ± 432.1	1,154.0 ± 616.7	.889
MVPA (min/day)	162.2 ± 75.8 (47.1–373.7)	159.8 ± 60.6	164.6 ± 89.8	.829
Steps/day	10,399 ± 3,261 (5,500–20,183)	10,133 ± 2,384	10,666 ± 3,987	.577
Sleep duration (ActiGraph) (h/day)	5.8 ± 1.3 (3.5–8.0)	5.9 ± 1.2	5.7 ± 1.4	.557
Awakenings per night (ActiGraph)	16.7 ± 6.7 (5.3–35)	14.1 ± 5.6	19.4 ± 6.7	.005
Sleep duration (PSQI) (h/day)	6.1 ± 1.5 (2–9)	6.4 ± 1.3	5.8 ± 1.6	.120
PSQI global score	13.4 ± 3.2 (7–21)	14.0 ± 3.1	13.3 ± 3.3	.418

Notes: BMI = body mass index; PA = physical activity; MVPA = moderate-to-vigorous physical activity; PSQI = Pittsburgh Sleep Quality Index.

($\rho = -0.21$, $P = .14$) or device-measured sleep duration ($\rho = -0.19$, $P = .19$). Sleep duration assessed by PSQI and device-measurement did not differ significantly (6.1 ± 1.5 vs. 5.8 ± 1.3 hours; $P = .23$). Sleep duration was inversely correlated with BMI ($\rho = -0.31$, $P = .03$), suggesting shorter sleep among overweight and obese patients (normal weight = 6.4 ± 1.2 , overweight = 5.3 ± 1.2 , and obese = 5.7 ± 1.2 hours/night; $P = .03$).

Table 2 presents daily patterns of sedentary behavior and light-to-moderate PA across 3 time intervals (8:00–11:59 AM, 12:00–4:59 PM, and 5:00–9:00 PM). Physical activity levels were highest in the afternoon and evening compared with the morning.

Table 2. Physical activity across time of day among participants with Inflammatory bowel disease

Variable	Morning (8:00–11:59 AM)	Afternoon (12:00–4:59 PM)	Evening (5:00–9:00 PM)
Sedentary (h/day)	1.4 ± 0.5	1.5 ± 0.5	$2.5 \pm 0.8^*$
Light PA (h/day)	$1.9 \pm 0.4^*$	2.7 ± 0.4	2.6 ± 0.6
Moderate PA (min/day)	$40.3 \pm 21.7^*$	50.9 ± 24.4	47.4 ± 23.7
MVPA (min/week)	$279.6 \pm 152.7^*$	358.0 ± 173.7	333.8 ± 163.3
MVPA (min/day)	$40.3 \pm 21.7^*$	50.9 ± 24.4	47.4 ± 23.7
Steps	$2,534 \pm 903^*$	$3,328 \pm 1,011$	$3,088 \pm 1,205$

Notes: PA = physical activity; MVPA = moderate-to-vigorous physical activity. * $P < .05$ (value with symbol is significantly different).

Discussion

Our study revealed that adult participants with IBD in Puerto Rico were, on average, overweight and physically active and generally experienced insufficient and poor-quality sleep. Compared with the general population in Puerto Rico (16), a higher proportion of IBD participants were in the normal weight category (40% vs. 26.1%), and fewer were overweight or obese (61% vs. 72%).

All the participants exceeded the minimum recommended MVPA levels (10), and, as reported in another study of patients with IBD (17), they engaged in light-to-moderate activities instead of moderate-to-vigorous activities. Our cohort was notably more active and less sedentary than previously reported in patients with IBD (17) and in the general population in Puerto Rico, in which only 34% met PA guidelines (16).

Self-reported and device-measured sleep duration were consistent, both falling below the recommended 7–9 hours per night (18). Poor sleep quality was confirmed by elevated PSQI scores and frequent awakenings. Despite the known benefits of PA on sleep (6,7), no association was found between MVPA and sleep quality or duration.

The inverse correlation between BMI and MVPA suggests that excess weight did not appear to hinder PA engagement. However, a direct correlation between BMI and reduced sleep duration raises

concerns, particularly for obese patients, given the established links between obesity and increased anxiety, depression, fatigue, pain, impaired social function, and risk of treatment failure (6).

While the relatively small sample size limits generalizability and subgroup comparisons, the unexpectedly high engagement in light-to-moderate PA warrants further investigation, particularly given the lack of association with sleep outcomes.

In conclusion, patients with IBD in Puerto Rico were predominantly overweight, were physically active in the afternoon and evening, and experienced poor sleep quality and insufficient sleep duration. Higher BMI was linked to increased PA but shorter sleep duration. Future research should assess sleep-related disorders and explore the relationship between subjective assessments and objective sleep metrics. Regular monitoring of PA, sleep, and anthropometric indicators is recommended to guide health interventions in this population of patients with IBD in Puerto Rico.

Resumen

Objetivo: La inactividad física y alteraciones del sueño afectan la salud y calidad de vida en personas con enfermedad inflamatoria intestinal (EII). En este estudio se describen características de actividad física (AF) y sueño en adultos con EII en Puerto Rico. **Métodos:** Participaron 24 mujeres y 24 hombres (edad = 42.1 ± 14.1 años): 73% con enfermedad de Crohn (EC) y 27% con colitis ulcerativa (CU); completando evaluaciones antropométricas y

utilizando un acelerómetro en la muñeca no dominante por siete días para medir AF y características de sueño. También se utilizó el Índice de Calidad de Sueño de Pittsburgh y el Cuestionario de Enfermedad Inflamatoria Intestinal en una sub-muestra ($n = 43$). **Resultados:** Participantes con IBD cumplieron con la recomendación de AF (≥ 150 min/semana), pero presentaron baja duración de sueño. Pacientes con EC tuvieron menor edad que aquellos con CU, pero fueron similares en AF, índice de masa corporal (IMC) y sueño. Los hombres tuvieron mayor estatura y peso que las mujeres, pero el IMC, la AF y características de sueño fueron similares, excepto que los hombres tuvieron mayores interrupciones de sueño. La AF fue mayor en la tarde y noche. No hubo correlaciones significativas entre AF y características de sueño. Sin embargo, el IMC correlacionó inversamente con la duración de sueño y directamente con la AF. **Conclusión:** Los participantes con IBD estuvieron en sobrepeso, fueron activos y tuvieron una duración corta de sueño. Monitorear antropometría, AF y sueño puede ayudar a desarrollar intervenciones de salud específicas para esta población.

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