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A Comparative Study of the Nature and Magnitude of Problems Sleeping in Inflammatory Bowel Disease (IBD) Compared to Healthy Controls

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Abstract

Inflammatory Bowel Disease (IBD) is commonly associated with poor global sleep quality, and has been posited as a modifiable determinant of IBD related outcomes, with recent calls to screen for, and subsequently treat problems sleeping as part of routine IBD care. However, there is little evidence on the specific *types* of problems sleeping (e.g., sleep apnea, insomnia etc.) that might characterize the poor sleep quality experienced by those with IBD. The present research aimed to investigate the severity of seven specific types of problems sleeping in those with IBD vs. a healthy control group. This cross-sectional comparison study recruited $N = 409$ with IBD, and $N = 377$ healthy controls (total sample $N = 786$). The Sleep-50 questionnaire was used to assess the presence of seven types of problems sleeping. Multivariate Analysis of Covariance (MANCOVA) was used to compare the severity of sleep disturbances between the IBD and control groups. Those in the IBD group reported significantly more severe experiences of five of the seven domains of the Sleep-50, including increased; sleep apnea, insomnia, narcolepsy, restless legs, and nightmares. In conclusion, those with a diagnosis of IBD reported significantly more severe symptoms across a range of specific problems sleeping when compared to controls. More research is needed to; i) improve the identification and treatment of problems sleeping in routine care; ii) understand the mechanism(s) of action that links problems sleeping to IBD related outcomes; and iii) develop adapted interventions to improve sleep in those with IBD.

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Keywords: Sleep; Inflammatory Bowel Disease; IBD; Crohn's Disease; Ulcerative Colitis.

A Comparative Study of the Nature and Magnitude of Problems Sleeping in Inflammatory Bowel Disease (IBD) Compared to Healthy Controls

In recent years, there has been a proliferation of research aiming to better understand the role of sleep in a range of physical (Gallicchio & Kalesan, 2009; O'brien et al., 2010; Pavlova, Ference, Hancock, & Noel, 2017; Wong et al., 2013), and mental health difficulties (Baglioni et al., 2011; Scott, Rowse, & Webb, 2017; Taylor, Lichstein, Durrence, Reidel, & Bush, 2005). The association between problems sleeping and health is particularly apparent in those with Inflammatory Bowel Disease (IBD) - a chronic and incurable disease involving inflammation of the gastrointestinal tract – where poor sleep quality is commonly reported (Kinnucan, Rubin, & Ali, 2013; Swanson, Burgess, & Keshavarzian, 2011; Wilson et al., 2015). Indeed, problems sleeping in those with IBD have been posited as a modifiable risk factor for a number of IBD related outcomes including diagnosis incidence (Ananthakrishnan et al., 2014), disease symptom flares (Ananthakrishnan, Long, Martin, Sandler, & Kappelman, 2013; Uemura et al., 2016), poorer health related quality of life (Keefer, Stepanski, Ranjbaran, Benson, & Keshavarzian, 2006; Ranjbaran, Keefer, Stepanski, Farhadi, & Keshavarzian, 2007; Uemura et al., 2016), and fatigue (Graff et al., 2013). However, despite a growing body of literature further elucidating our understanding of the experience of sleep in those with IBD, there remains a number of opportunities that would facilitate calls to screen for, and subsequently treat problems sleeping in those with IBD (Almedimigh et al., 2018; Kinnucan et al., 2013).

Opportunities for Advancement

To date, the majority of research into the role of sleep disturbances in those with IBD has tended to rely on more global measures of sleep quality (e.g., the Pittsburgh Sleep Quality Index (PSQI); Buysse, Reynolds, Monk, Berman, & Kupfer, 1989), rather than measures able to detect *specific* types of problems sleeping. For example, the PSQI can tell us somebody

has poor, or good self-reported sleep quality; however, it cannot tell us this is due to the experience of specific types of problems sleeping (e.g., due to insomnia, sleep apneoa, nightmares etc.). Although there is evidence suggesting that those with IBD may experience specific types of problems sleeping more commonly, including symptoms of sleep apnea (Keefer et al., 2006), restless legs (Becker et al., 2018; Keefer et al., 2006), and nightmares (Ranjbaran et al., 2007); the conclusions that can be drawn are limited - in that findings are often reliant on single-item measures of specific problems sleeping, and/or small sample sizes leading to underpowered studies. Consequently, is important that research also uses multi-item measures of specific sleep disturbances along with larger samples to drawn more robust conclusions. Secondly, few studies have compared the problems sleeping seen in IBD to healthy controls (i.e., those without gastrointestinal diagnoses). Consequently, it is unclear whether both the type and magnitude of problems sleeping differ between those with, and without a diagnosis of IBD.

The present research

The lack of research investigating specific types of sleep disturbance in IBD relative to healthy controls serves to inhibit two important avenues; i) the development and adaption of interventions to target specific sleep disturbances experienced by those with IBD as a route to improving IBD related outcomes; and ii) as has been recently suggested, the incorporation of sleep disturbance screening into the routine clinical management of IBD (Almedimigh et al., 2018; Kinnucan et al., 2013). The present research aims to address this by measuring the severity of multiple types of specific problems sleeping in those with diagnosis of IBD relative to healthy controls. We hope that doing so will provide a more comprehensive profile of the types of problems sleeping that are experienced by people with IBD, with each type generally having specific screening and treatment options.

Materials and Methods

Participants

The IBD group were recruited from three sources; (i) through an advertisement placed on a national IBD charity website in the UK (Crohn's & Colitis UK); (ii) from IBD specific online support groups; and (iii) from volunteer lists maintained by the research team. The healthy control group was recruited from two sources; (i) from volunteer lists maintained by the research team; and (ii) via a social media advertising campaign. Enrolment to the study began in May 2017, and concluded in November 2017. Prior to taking part in the present research, all participants were asked a number of screening and eligibility questions. To be eligible for the IBD group, participants were required to; (i) have a diagnosis of IBD; and (ii) be at least 16 years of age or older. To be eligible for inclusion in the control group, participants were required to; (i) have no diagnosis of any gastrointestinal disorder (e.g., IBD, Irritable Bowel Syndrome, coeliac disease etc.); and (ii) be at least 16 years of age or older. Participants not meeting these criteria, those who did not provide full informed consent, and those who did not start the online survey were excluded.

Procedure

Participants were invited to take part in an online study aiming to investigate the severity of problems sleeping in those with, and without, a diagnosis of IBD. All outcome measures were delivered anonymously online using Qualtrics, a web based survey hosting platform (Qualtrics, 2018). Participants first read an information sheet detailing aspects of the research before confirming eligibility via a series of screening items in line with the studies inclusion and exclusion criteria. If eligible, participants provided electronic consent to participate. The Research Ethics Committee based in the School of Health and Related Research (ScHARR), University of Sheffield, granted ethical approval.

Outcome Measures

Demographics

All participants were asked to provide information relating to their age, gender, and whether they were currently receiving psychological therapy and/or medication for a mental health or sleep related problem. Participants in the IBD group were asked a number of items relating to their IBD, including their IBD diagnosis type (Ulcerative Colitis or Crohn's Disease), number of years living with an IBD diagnosis, whether they had ever undergone IBD related surgery, current and/or previous use of a stoma, and whether they were currently taking medication for their IBD.

The Sleep-50 Questionnaire

The Sleep-50 is a 50 item self-report instrument designed to measure symptoms of seven specific types of sleep disturbances (sleep apnea, insomnia, narcolepsy, restless legs, circadian rhythm disruption, sleepwalking, & nightmares), as well as factors influencing sleep (e.g., low mood, sleep environment not optimal, medication use), and the impact of sleep complaints of daily functioning (e.g., feeling tired on awakening, difficulty concentrating, worrying about sleep). Using a 4-point scale, participants are asked to rate the extent to which they endorse each item over the last 4-weeks, ranging from 'not at all' through to 'very much'. The Sleep-50 has been validated for use in both general population samples, and those with clinically defined sleep disorders, demonstrating a clear factor structure, high internal consistency, and good test-retest reliability (Spoormaker, Verbeek, van den Bout, & Klip, 2005).

The Short Inflammatory Bowel Disease Questionnaire (SIBDQ)

The bowel symptoms subscale of the SIBDQ (Jowett, Seal, Barton, & Welfare, 2001) was used as a proxy measure of disease symptom activity in the IBD group. The bowel symptom subscale of the SIBDQ asks participants to rate the extent to which they endorse

three items pertaining to the frequency of IBD symptoms on a 5-point scale, with lower scores indicating more frequent symptom activity. For example, participants are asked, "*How often in the last two weeks have you been troubled by pain in the abdomen?*". The bowel symptoms subscale correlates strongly with several validated measures of disease activity (Jowett et al., 2001), including the Simple Clinical Colitis Activity Index (SCCAI; Walmsley, Ayres, Pounder, & Allan, 1998), and the Seo index (Seo et al., 1992), suggesting its valid use as a proxy measure of disease activity.

Approach to Analysis

A one-way multivariate analysis of covariance (MANCOVA) was conducted to investigate the severity of seven specific types of sleep disturbances measured by the Sleep-50, as well as factors influencing sleep, and the impact of sleep complaints on daily functioning in the IBD group relative to controls. Where the MANCOVA demonstrated significant differences between the IBD and control groups in terms of the type of problem sleeping, a sensitivity analysis in the form of hierarchical linear regression (including only the IBD group) was conducted to investigate whether any IBD related characteristics were significantly associated with the sleep disturbance. G-Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) was used to determine the sample size. For the MANCOVA, based on a small-to-medium sized effect at 90% power, and a strict significance threshold of $p < .001$, the desired total sample size is $N = 560$. Given that the heirarchical linear regression includes only the IBD group, a less conservative alpha level was set; based on a small-to-medium sized effect at 90% power, and a significance threshold of $p < .05$, the desired total sample size is $N = 263$.

Results

Participants

Of the *N* = 498 participants in the IBD group who started the study procedures, N = 409 (82%) were included in the study, with *N* = 89 (18%) excluded. Of those excluded in the IBD group, *N* = 9 (10%) were under the age of 16, *N* = 7 (8%) had no diagnosis of IBD, *N* = 22 (25%) did not provide consent to take part, and *N* = 51 (57%) did not start the online surveys. With regards to the control group, *N* = 472 began the study procedures with *N* = 377 (88%) included in the study. Of the *N* = 50 (12%) who were excluded, *N* = 3 (6%) were under the age of 16, *N* = 4 (8%) had a diagnosis of IBD, *N* = 20 (40%) had diagnosis of Irritable Bowel Syndrome (IBS), *N* = 10 (20%) did not provide consent to take part, and *N* = 13 (26%) did not start the online surveys. Figure 1 describes of the flow of participants through the study, while Table 1 presents the demographic and clinical characteristics of both groups.

Figure 1

A CONSORT Flow Diagram Showing the Flow of Participants Through the Study

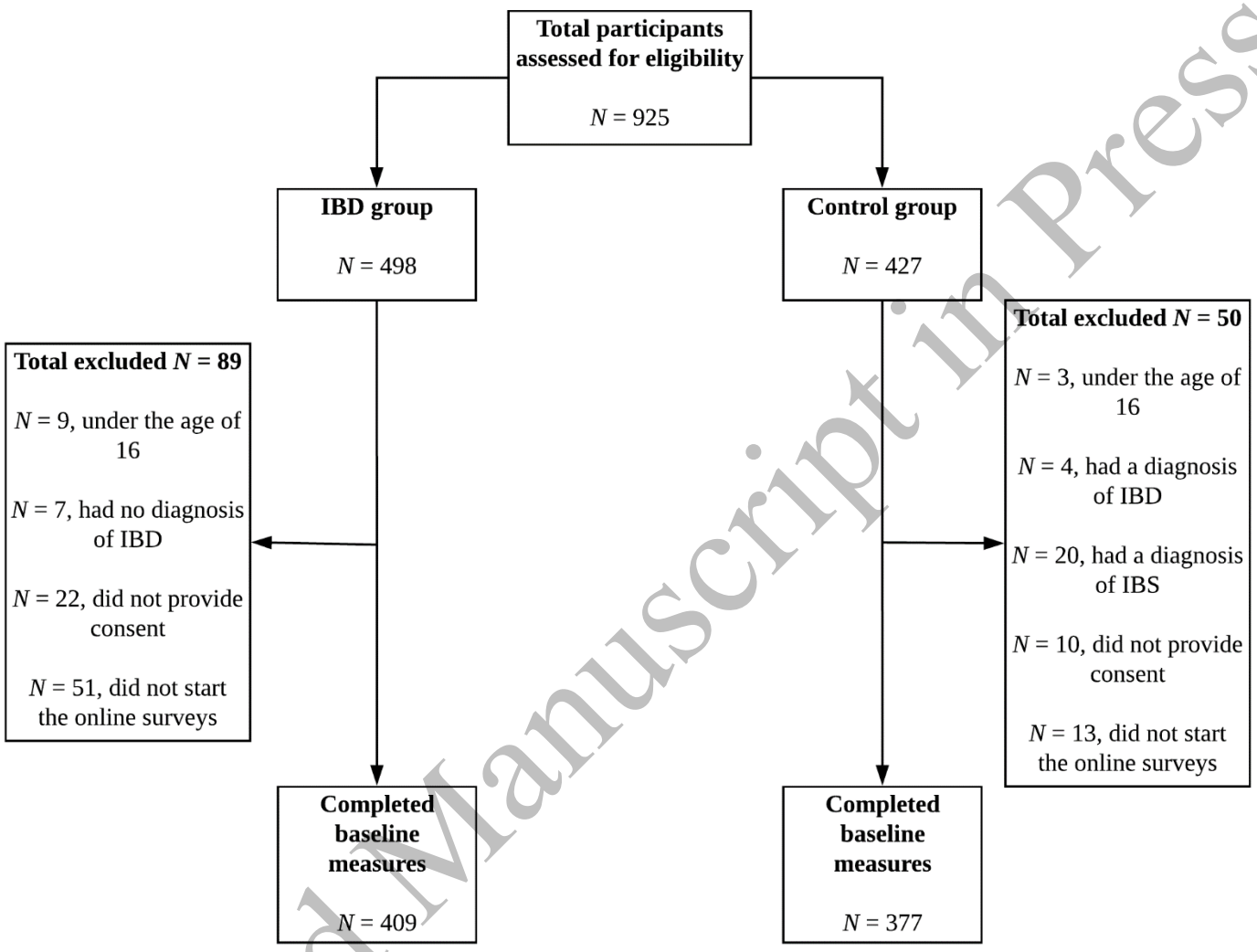

Table 1

Baseline Sample Characteristics of the IBD and Control Group

Variable	IBD group (N = 409)	Control group (N = 377)
Age, M (SD)	33.86 (11.57)	39.60 (14.51)
Gender, N (%)		
Male	74 (18%)	100 (27%)
Female	335 (82%)	277 (73%)
Sleep medication use, N (%)		
Yes	96 (23%)	17 (5%)
No	313 (77%)	360 (95%)
Sleep therapy, N (%)		
Yes	21 (5%)	3 (1%)
No	388 (95%)	374 (99%)
IBD type, N (%)		
Ulcerative Colitis (UC)	155 (38%)	-
Crohn's Diseases (CD)	254 (62%)	-
Years with IBD diagnosis, M (SD)	9.12 (8.52)	-
Surgery for IBD, N (%)		
Yes	172 (42%)	-
No	237 (58%)	-
Current stoma, N (%)		
Yes	58 (14%)	-
No	351 (86%)	-
Previous stoma, N (%)		
Yes	64 (16%)	-
No	345 (84%)	-
Immunosuppressant use, N (%)		
Yes	259 (63%)	-
No	150 (37%)	-

Does specific sleep disturbance severity differ between groups?

MANCOVA (controlling for age and gender) was used to examine whether the severity of specific sleep disturbances differed between those in the IBD group vs. the control group (see Table 2 for an overview of these analyses). There was a statistically significant multivariate difference between groups ($F(9, 774) = 50.44$, $p < 0.001$, $Eta^2 = 0.08$), in that participants in the IBD group reported significantly more profound sleep disturbance than the control group. This effect was reflected in significantly more severe sleep disturbance across seven of the eight subscales measured by the Sleep-50, including symptom severity of; **sleep apnea** ($F(1, 782) = 12.94$, $p < 0.001$, $Eta^2 = 0.02$), **insomnia** ($F(1, 782) = 31.89$, $p < 0.001$, $Eta^2 = 0.04$), **narcolepsy** ($F(1, 782) = 16.01$, $p < 0.001$, $Eta^2 = 0.02$), **restless legs** ($F(1, 782) = 17.98$, $p < 0.001$, $Eta^2 = 0.02$), **nightmares** ($F(1, 782) = 13.87$, $p < 0.001$, $Eta^2 = 0.02$), **factors influencing sleep** ($F(1, 782) = 35.81$, $p < 0.001$, $Eta^2 = 0.04$), and the **impact of sleep disturbance on daily life** ($F(1, 782) = 63.69$, $p < 0.001$, $Eta^2 = 0.08$). There were no significance differences between groups on the severity of **circadian rhythm disruptions** ($F(1, 782) = 7.34$, $p = 0.01$, $Eta^2 = 0.01$), or **sleepwalking** ($F(1, 782) = 4.48$, $p = 0.04$, $Eta^2 = 0.01$).

Table 2

Descriptive Statistics and Between Group Comparisons of Sleep Disorder(s) in the IBD group vs. Controls

	IBD group (*N* = 409)		**Control group (*N* = 377)**				
Sleep outcome	**M**	**SD**	**M**	**SD**	***F***	***p***	**Eta²**
Sleep-50 total	95.47	20.48	84.88	21.38	50.44	**< 0.001**	0.08
Sleep apnoea	14.03	3.49	13.19	3.99	12.94	**< 0.001**	0.02
Insomnia	20.33	3.49	17.99	5.57	31.89	**< 0.001**	0.04
Narcolepsy	7.74	2.34	7.06	2.29	16.01	**< 0.001**	0.02
Restless legs	6.59	2.47	5.87	2.41	17.98	**< 0.001**	0.02
Circadian rhythm disruption	5.23	2.01	4.79	1.80	7.34	0.01	0.01
Sleepwalking	3.36	0.99	3.23	0.78	4.48	0.04	0.01
Nightmares	8.29	5.51	6.73	5.65	13.87	**< 0.001**	0.02
Factors influencing sleep	11.09	2.71	9.94	2.50	35.81	**< 0.001**	0.04
Impact on daily function	18.89	4.87	16.08	5.18	63.69	**< 0.001**	0.08

Note: M = mean, SD = standard deviation, *p* values in bold type represent statistically significant effects at $p < 0.001$.

195 **Clinical correlates of sleep disturbance in the IBD group**

196 Where there was a significant difference between the IBD and control group in the
197 preceding analysis, a sensitivity analysis was conducted using only the IBD group to investigate
198 potential clinical correlates of sleep disturbances. Table 3 presents the detailed results of this
199 analysis; however, in short, none of the characteristics of the IBD group were associated with the
200 experience of sleep apnoea ($F(8, 375) = 0.61$, $p = 0.77$), narcolepsy ($F(8, 375) = 0.46$, $p = 0.88$),
201 or nightmares ($F(8, 375) = 0.71$, $p = 0.68$). However, a higher IBD symptom activity as
202 measured by the bowel symptom subscale of the SIBDQ was negatively associated with
203 increased insomnia severity ($\beta = -0.14$, $p = 0.01$), restless legs symptom severity ($\beta = -0.14$, $p =$
204 0.03), increased factors influencing sleep, ($\beta = -0.15$, $p = 0.01$), and increased impact of sleep
205 disturbances on daily function ($\beta = -0.13$, $p = 0.01$). Furthermore, IBD diagnosis type was
206 associated with the impact of sleep complaints on daily function ($\beta = 0.14$, $p = 0.01$), with those
207 diagnosed with Ulcerative Colitis reporting more daily impact.
208

Table 3

Clinical Correlates of Specific Sleep Disturbances in the Inflammatory Bowel Disease (IBD) Group

Sleep problem	*β*	*t*	*p*
Sleep apnea			
Age	-0.02	-0.31	0.75
Gender	-0.02	-0.40	0.69
IBD type	0.02	0.30	0.76
Years with IBD	-0.01	-0.09	0.93
IBD surgery	0.06	0.91	0.36
Current stoma	0.04	0.74	0.46
IBD medication	0.01	0.27	0.79
IBD symptom activity	-0.02	-0.44	0.66
Insomnia			
Age	-0.10	-1.62	0.11
Gender	-0.05	-0.91	0.36
IBD type	0.02	0.37	0.71
Years with IBD	0.05	0.79	0.43
IBD surgery	-0.07	-1.02	0.31
Current stoma	0.06	1.01	0.31
IBD medication	0.04	0.78	0.44
IBD symptom activity	-0.12	-2.21	**0.03**
Narcolepsy			
Age	-0.03	-0.55	0.59
Gender	0.02	0.43	0.66
IBD type	0.06	0.98	0.33
Years with IBD	-0.04	-0.65	0.52
IBD surgery	-0.05	-0.81	0.42
Current stoma	-0.03	-0.46	0.65
IBD medication	-0.05	-0.98	0.33

IBD symptom activity	-0.04	-0.65	0.51
Restless legs			
Age	0.04	0.75	0.45
Gender	0.02	0.31	0.75
IBD type	-0.01	-0.19	0.85
Years with IBD	-0.02	-0.24	0.81
IBD surgery	-0.01	-0.20	0.84
Current stoma	0.07	1.13	0.26
IBD medication	0.01	0.10	0.92
IBD symptom activity	-0.12	-2.22	**0.03**
Nightmares			
Age	0.01	0.19	0.85
Gender	0.04	0.76	0.45
IBD type	0.01	0.12	0.91
Years with IBD	-0.10	-1.53	0.13
IBD surgery	-0.11	-1.76	0.08
Current stoma	0.10	1.67	0.10
IBD medication	-0.02	-0.32	0.75
IBD symptom activity	0.06	1.16	0.25
Factors influencing sleep			
Age	-0.05	-0.81	0.42
Gender	-0.04	-0.80	0.42
IBD type	0.07	1.22	0.22
Years with IBD	0.07	1.11	0.27
IBD surgery	-0.06	-0.92	0.36
Current stoma	0.04	0.71	0.48
IBD medication	0.06	1.13	0.26
IBD symptom activity	-0.15	-2.70	**0.01**
Impact on daily function			
Age	0.02	0.35	0.73
Gender	-0.03	-0.60	0.55

IBD type	0.14	2.56	**0.01**
Years with IBD	0.01	0.17	0.86
IBD surgery	-0.06	-0.99	0.32
Current stoma	-0.07	-1.13	0.26
IBD medication	0.01	0.26	0.79
IBD symptom activity	-0.13	-2.48	**0.01**

212 *Note: p* values in bold type represent statistically significant effects at $p < 0.05$

Discussion

The present research aimed to investigate the nature and magnitude of specific types of problems sleeping in those with IBD relative to a healthy control group (i.e., no gastrointestinal diagnoses). Our findings suggest that relative to controls, those with IBD reported significantly more severe symptoms of five of the seven sleep disturbances measured by the Sleep-50, including; sleep apnea, insomnia, narcolepsy, restless legs, and nightmares. Furthermore, those with IBD reported experiencing significantly more factors that are known to influence sleep (e.g., low mood, sleep environment not optimal, medication use), and a greater impact of sleep disturbances on daily life (e.g., feeling tired on awakening, difficulty concentrating, worrying about sleep). Interestingly, only the experience of insomnia, and the impact of sleep disturbances on daily life was associated with some clinical features of IBD. Greater insomnia severity was associated with more frequent IBD symptoms, whereas a diagnosis of Ulcerative Colitis was significantly associated with a greater impact of sleep disturbances on daily life.

The key finding reported in the present research is that those with IBD reported more severe experiences of a variety of specific problems sleeping, including; sleep apnea, insomnia, narcolepsy, restless legs, and nightmares, as well as more disruptions to factors known to influence sleep, and a greater impact of sleep disturbances on daily life. Although the majority of extant research reports the association between global sleep quality and IBD, the few studies that have examined specific types of problems sleeping are supported by the present research. For example, the findings reported here support previous research suggesting that those with IBD experience sleep disordered breathing (i.e., a core symptom of sleep apnoea, Keefer et al., 2006), restless legs (Becker et al., 2018; Keefer et al., 2006), and nightmares (Ranjbaran et al., 2007). As well as strengthening existing findings using a larger sample size, and a multi-item measure

specific problems sleeping, the findings reported here also extend previous work by reporting an increased severity of insomnia, and narcolepsy symptoms in the IBD group relative to controls. Although more research is warranted, these findings suggest that the routine care of those with IBD might consider incorporating assessments to screen for the presence a variety of specific types of problems sleeping.

Future directions

It seems clear that problems sleeping are associated with IBD, and may even represent a core experience of IBD itself (Keefer et al., 2006). However, *how* problems sleeping are related to IBD, and the direction that best explains this association is currently unclear. Consequently, future research might seek to elucidate the mechanisms of action that can explain how problems sleeping can exert an effect on IBD related outcomes, using designs able to inform the direction of effect. Research that is well placed to disentangle the impact of mediators and the direction of association between sleep and IBD outcomes are those that employ longitudinal designs (i.e., designs that measure variables over time, so that the temporal relationship between variables can be investigated), research that is currently lacking (for notable exceptions, see Ananthakrishnan et al., 2014; Ananthakrishnan et al., 2013; Graff et al., 2013; Uemura et al., 2016). Problems sleeping have been posited as a possible modifiable environmental risk factor that can adversely affect IBD outcomes. However, despite recent calls to screen for, and subsequently treat problems sleeping in those with IBD (Almedimigh et al., 2018; Kinnucan et al., 2013), there are relatively few guidelines to facilitate clinical decision making in this area (National Institute for Health and Care Excellence, 2015; Kinnucan et al., 2013). Therefore, future research might profitably seek to understand the barriers and facilitators to effective sleep management in routine IBD care, from both the patients', and healthcare professional's perspectives as a route to

developing effective guidelines to facilitate the detection and subsequent treatment of specific sleep disturbances in those with IBD.

Limitations of the present research

Firstly, the present study recruited participants based on a self-reported IBD diagnosis. Although recent research has demonstrated that self-reported diagnosis in online research has a high concordance rate with physician diagnoses (Kelstrup, Juillerat, & Korzenik, 2014; Randell et al., 2014), this should be taken into account when considering the present findings. Secondly, a large proportion of the participants from which the present findings are based are female. This is perhaps not surprising given that there is evidence to suggest that there is a greater prevalence of IBD in women when compared to men (Bernstein, Blanchard, Rawsthorne, & Wajda, 1999; Brant & Nguyen, 2008). Indeed, findings based on majority female participants are a common occurrence in the sleep-IBD literature (Ananthakrishnan et al., 2014; Ananthakrishnan et al., 2013; Graff et al., 2013), and in epidemiological research more broadly (Dunn, Jordan, Lacey, Shapley, & Jinks, 2004; Galea & Tracy, 2007; Smith, 2008). The large sample size in the present research does mitigate some of the effects of sample representativeness, and the analyses controlled the effects of gender (gender was not associated with outcomes). That being said, the gender distributions in the present research need to be taken into account when interpreting the findings.

Conclusions

The present research found that, relative to controls, those with a diagnosis of IBD reported significantly more severe experiences of sleep apnea, insomnia, narcolepsy, restless legs, and nightmares, as well as more factors that influence sleep, and a greater impact of sleep complaints on daily life. We recommend that future research should explore three possible

avenues; i) investigation of the barriers/facilitators to the effective management of problems sleeping in the routine care of those with IBD; ii) research aiming to elucidate the directional association between sleep and IBD related outcomes, as well as any mechanisms of action; and iii) the effectiveness and efficacy of interventions designed to improve sleep as a route to improving IBD related outcomes. We hope that the present research will highlight the nature and magnitude of problems sleeping in those with IBD, and facilitate more research in this area.

References

Almedimigh, A., Szeto, S., Dave, J., Alsulaimi, N., Myint, A., & Borum, M. L. (2018). P108 Sleep disorders in inflammatory bowel disease: The forgotten discussion. *Gastroenterology, 154*(1), S56. Doi: https://doi.org/10.1053/j.gastro.2017.11.154.

Ananthakrishnan, A. N., Khalili, H., Konijeti, G. G., Higuchi, L. M., de Silva, P., Fuchs, C. S., . . . Chan, A. T. (2014). Sleep duration affects risk for ulcerative colitis: A prospective cohort study. *Clinical Gastroenterology and Hepatology, 12*(11), 1879-1886. Doi:10.1016/j.cgh.2014.04.021.

Ananthakrishnan, A. N., Long, M. D., Martin, C. F., Sandler, R. S., & Kappelman, M. D. (2013). Sleep disturbance and risk of active disease in patients with crohn's disease and ulcerative colitis. *Clinical Gastroenterology and Hepatology, 11*(8), 965-971. Doi: 10.1016/j.cgh.2013.01.021.

Baglioni, C., Battagliese, G., Feige, B., Spiegelhalder, K., Nissen, C., Voderholzer, U., . . . Riemann, D. (2011). Insomnia as a predictor of depression: A meta-analytic evaluation of longitudinal epidemiological studies. *Journal of Affective Disorders, 135*(1), 10-19. Doi: https://doi.org/10.1016/j.jad.2011.01.011.

Becker, J., Berger, F., Schindlbeck, K. A., Poddubnyy, D., Koch, P. M., Preiß, J. C., . . . Maul, J. (2018). Restless legs syndrome is a relevant comorbidity in patients with inflammatory bowel disease. *International Journal of Colorectal Disease*, 1-8. Doi: https://doi.org/10.1007/s00384-018-3032-8.

Bernstein, C. N., Blanchard, J. F., Rawsthorne, P., & Wajda, A. (1999). Epidemiology of Crohn's disease and Ulcerative Colitis in a central Canadian province: A population-based study.

American Journal of Epidemiology, 149(10), 916-924. Doi: https://doi.org/10.1093/oxfordjournals.aje.a009735.

Brant, S. R., & Nguyen, G. C. (2008). Is there a gender difference in the prevalence of crohn's disease or ulcerative colitis? *Inflammatory Bowel Diseases, 14*, S2-S3. Doi: https://doi.org/10.1002/ibd.20540.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193-213. Doi: https://doi.org/10.1016/0165-1781(89)90047-4.

Dunn, K. M., Jordan, K., Lacey, R. J., Shapley, M., & Jinks, C. (2004). Patterns of consent in epidemiologic research: Evidence from over 25,000 responders. *American Journal of Epidemiology, 159*(11), 1087-1094. Doi: https://doi.org/10.1093/aje/kwh141.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G* power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. Doi: https://doi.org/10.3758/BF03193146.

Galea, S., & Tracy, M. (2007). Participation rates in epidemiologic studies. *Annals of Epidemiology, 17*(9), 643-653. Doi: https://doi.org/10.1016/j.annepidem.2007.03.013.

Gallicchio, L., & Kalesan, B. (2009). Sleep duration and mortality: A systematic review and meta-analysis. *Journal of Sleep Research, 18*(2), 148-158. Doi: https://doi.org/10.1111/j.1365-2869.2008.00732.x.

Graff, L., Clara, I., Walker, J., Lix, L., Carr, R., Miller, N., . . . Bernstein, C. (2013). Changes in fatigue over 2 years are associated with activity of inflammatory bowel disease and

psychological factors. *Clinical Gastroenterology and Hepatology, 11*(9), 1140-1146. Doi: https://doi.org/10.1016/j.cgh.2013.03.031.

Jowett, S. L., Seal, C. J., Barton, J. R., & Welfare, M. R. (2001). The short inflammatory bowel disease questionnaire is reliable and responsive to clinically important change in ulcerative colitis. *The American Journal of Gastroenterology, 96*(10), 2921. Doi: 10.1111/j.1572-0241.2001.04682.x

Keefer, L., Stepanski, E. J., Ranjbaran, Z., Benson, L. M., & Keshavarzian, A. (2006). An initial report of sleep disturbance in inactive inflammatory bowel disease. *Journal of Clinical Sleep Medicine, 2*(4), 409-416.

Kelstrup, A. M., Juillerat, P., & Korzenik, J. (2014). The accuracy of self-reported medical history: A preliminary analysis of the promise of internet-based research in inflammatory bowel diseases. *Journal of Crohn's and Colitis, 8*(5), 349-356. Doi: https://doi.org/10.1016/j.crohns.2013.09.012.

Kinnucan, J. A., Rubin, D. T., & Ali, T. (2013). Sleep and inflammatory bowel disease: Exploring the relationship between sleep disturbances and inflammation. *Gastroenterology & Hepatology, 9*(11), 718-727.

National Institute for Health and Care Excellence (NICE). (2015). Inflammatory bowel disease quality standard (qs81). Retrieved from https://www.nice.org.uk/guidance/qs81

O'Brien, E. M., Waxenberg, L. B., Atchison, J. W., Gremillion, H. A., Staud, R. M., McCrae, C. S., & Robinson, M. E. (2010). Negative mood mediates the effect of poor sleep on pain among chronic pain patients. *The Clinical Journal of Pain, 26*(4), 310-319. Doi: 10.1097/AJP.0b013e3181c328e9.

Pavlova, M., Ference, J., Hancock, M., & Noel, M. (2017). Disentangling the sleep-pain relationship in pediatric chronic pain: The mediating role of internalizing mental health symptoms. *Pain Research and Management, 2017*. Doi: https://doi.org/10.1155/2017/1586921.

Qualtrics. (2018). Provo, Utah, USA. Retrieved from https://www.qualtrics.com/

Randell, R., Long, M., Cook, S., Wrennall, C., Chen, W., Martin, C., & Anton, K. (2014). Validation of an internet-based cohort of inflammatory bowel disease (CCFA partners) Inflammatory Bowel Disease. 2014; 20 (3): 541–544. Doi: 10.1097/01. *MIB, 441348*, 34.

Ranjbaran, Z., Keefer, L., Stepanski, E., Farhadi, A., & Keshavarzian, A. (2007). The relevance of sleep abnormalities to chronic inflammatory conditions. *Inflammation Research, 56*(2), 51-57. Doi: 10.1007/s00011-006-6067-1.

Scott, A. J., Rowse, G., & Webb, T. L. (2017). A structural equation model of the relationship between insomnia, negative affect, and paranoid thinking. *PLOS ONE, 12*(10), e0186233. Doi:10.1371/journal.pone.0186233

Seo, M., Okada, M., Yao, T., Ueki, M., Arima, S., & Okumura, M. (1992). An index of disease activity in patients with ulcerative colitis. *American Journal of Gastroenterology, 87*(8).

Smith, W. G. (2008). Does gender influence online survey participation? A record-linkage analysis of university faculty online survey response behavior. *ERIC Document Reproduction Service No. ED 501717*.

Spoormaker, V. I., Verbeek, I., van den Bout, J., & Klip, E. C. (2005). Initial validation of the sleep-50 questionnaire. *Behavioral Sleep Medicine, 3*(4), 227-246. Doi: https://doi.org/10.1207/s15402010bsm0304_4.

Swanson, G. R., Burgess, H. J., & Keshavarzian, A. (2011). Sleep disturbances and inflammatory bowel disease: A potential trigger for disease flare? *Expert Review of Clinical Immunology, 7*(1), 29-36. Doi:10.1586/eci.10.83

Taylor, D. J., Lichstein, K. L., Durrence, H. H., Reidel, B. W., & Bush, A. J. (2005). Epidemiology of insomnia, depression, and anxiety. *Sleep, 28*(11), 1457-1464. Doi: https://doi.org/10.1093/sleep/28.11.1457.

Uemura, R., Fujiwara, Y., Iwakura, N., Shiba, M., Watanabe, K., Kamata, N., . . . Arakawa, T. (2016). Sleep disturbances in japanese patients with inflammatory bowel disease and their impact on disease flare. *Springerplus, 5*(5), 1792. Doi:10.1186/s40064-016-3408-6

Walmsley, R., Ayres, R., Pounder, R., & Allan, R. (1998). A simple clinical colitis activity index. *Gut, 43*(1), 29-32. Doi: http://dx.doi.org/10.1136/gut.43.1.29.

Wilson, R. G., Stevens, B. W., Guo, A. Y., Russell, C. N., Thornton, A., Cohen, M. A., . . . Ananthakrishnan, A. N. (2015). High c-reactive protein is associated with poor sleep quality independent of nocturnal symptoms in patients with inflammatory bowel disease. *Digestive Diseases and Sciences, 60*(7), 2136-2143. Doi:10.1007/s10620-015-3580-5

Wong, M. L., Lau, E. Y. Y., Wan, J. H. Y., Cheung, S. F., Hui, C. H., & Mok, D. S. Y. (2013). The interplay between sleep and mood in predicting academic functioning, physical health and psychological health: A longitudinal study. *Journal of Psychosomatic Research, 74*(4), 271-277. Doi: 10.1016/j.jpsychores.2012.08.014.