The Daytime Impact of *DSM-5* Insomnia Disorder: Comparative Analysis of Insomnia Subtypes From the Great British Sleep Survey

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ABSTRACT

Objective: To profile the daytime impact of the proposed *DSM-5* insomnia disorder diagnosis, with and without mental health, physical health, or other sleep disorder comorbidities; to better understand how specific daytime symptom patterns are associated with nighttime sleep in insomnia; and to compare childhood-onset and adulthood-onset insomnia disorder with respect to daytime dysfunction.

Method: Data were derived from the Great British Sleep Survey (GBSS), an open-access online population survey completed by adults who had a valid postcode and were residents of the United Kingdom. The primary variables of interest were the 6 areas that, according to the proposed *DSM-5* criteria, may be impacted in the daytime by insomnia disorder: energy, concentration, relationships, ability to stay awake, mood, and ability to get through work. These variables were compared for those with versus those without insomnia disorder and across 5 insomnia subtypes (difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, a combination of these 3 core symptoms, or nonrestorative sleep). Clinically comorbid insomnia presentations (insomnia disorder with poor mental health/poor physical health/additional sleep disorder symptoms) and insomnia disorder of childhood versus adult onset were also evaluated.

Results: A total of 11,129 participants (72% female; mean age = 39 years) completed the GBSS between March 2010 and April 2011, of whom 5,083 screened as having possible insomnia disorder. Compared with those who did not have insomnia disorder, those with insomnia disorder reported greater impairment in all areas of daytime functioning (Cohen *d* range, 0.68–1.30). The greatest effects reflected negative impact on energy and mood. Participants with a combination of insomnia symptoms tended to be the most impaired (Cohen *d* range, 0.10–0.23), whereas no consistent differences emerged between the other 4 subtypes. Finally, individuals who had both insomnia disorder and poor mental health were consistently the most impaired comorbid group (Cohen *d* range, 0.15–0.65), and childhood-onset insomnia disorder had greater daytime impact than adult-onset insomnia disorder ($P < .05$ for energy; $P < .01$ for mood, concentration, and getting through work).

Conclusions: The severity of daytime impact of *DSM-5* insomnia disorder varies by insomnia type. This finding has implications for the evaluation and management of insomnia in clinical practice.

J Clin Psychiatry 2012;73(12):e1478–e1484

Submitted: *June 18, 2012; accepted August 16, 2012 (doi:10.4088/JCP.12m07954).*
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The adoption in *DSM-5* of the term *insomnia disorder* (ID) (M 00) reflects a paradigm shift, recommended by the National Institutes of Health,[1] toward coding insomnia "whenever diagnostic criteria are met, whether or not there is a coexisting psychiatric, medical, or another sleep disorder."[2] In laying aside the *DSM-IV*[3] perspective of "primary" versus "secondary" insomnia, the *DSM-5* Sleep-Wake Disorders Work Group has recognized that poor sleep may be associated with illness vulnerability.[4] For example, chronic insomnia is a risk factor for the evolution of, and relapse into, depression,[5] and cotreatment of insomnia improves depression outcomes.[6,7] Likewise, insomnia has been associated with physical disease (eg, hypertension,[8] type 2 diabetes[9]) and all-cause mortality[10] and often copresents with sleep apnea[11] where, if untreated, may exacerbate daytime impairment, particularly excessive daytime sleepiness.[12] A further development in *DSM-5*, consistent with research diagnostic criteria and contemporary data,[13,14] is that insomnia must have a specified sequela (fatigue, daytime sleepiness, cognitive impairment, mood disturbance, impaired work function, impaired interpersonal function),[2] contrasting with the general *DSM-IV* statement of "significant distress or impairment in social, occupational, or other important areas of functioning."[3(p557)]

It seems timely to consider how these domains of daytime impairment might associate, in nature or severity, with the ID subtypes of difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, and nonrestorative sleep. Although their investigation did not use *DSM-5* criteria, Léger et al,[15] reporting on primary care patients (n = 3,384), found that those with a combination of nighttime symptoms had the most severe impairments. In a controlled laboratory study, Roth et al[16] found that patients with nonrestorative sleep (n = 115) reported daytime impairment similar in magnitude to those with difficulty initiating sleep (n = 56), difficulty maintaining sleep (n = 18), or a combination of symptoms (n = 37). Walsh et al[17] found that nonrestorative sleep was associated with the poorest perceived health in a well-defined sample of US health plan members (n = 6,791). The identification of *both* nighttime and daytime symptoms may be particularly important in advancing understanding of how insomnia impacts mental health.[18,19] Clinical history also requires further study. Preliminary reports suggest that childhood-onset insomnia is associated with more severe sleep complaints and a different profile of daytime dysfunction relative to adult-onset insomnia.[20–22]

Clinical Points

- *DSM-5* proposes to move away from "primary" and "secondary" insomnia, recognizing that causality is often hard to determine, that sleep and comorbid conditions interact in a bidirectional manner, and that sleep disturbance is associated with illness vulnerability.
- The new diagnostic entity of insomnia disorder highlights that significant sleep disturbance merits independent clinical attention, regardless of additional comorbidities.
- The daytime consequences of insomnia disorder are most pronounced for those with a mixed subtype (problems with both initiating and maintaining sleep), those with poor mental health, and those with insomnia of childhood onset.

In March 2010, the Great British Sleep Survey (GBSS), an online population survey based on detailed *DSM-5* criteria, was launched. The survey was conducted by Sleepio Limited (an organization dedicated to helping people sleep better through raising awareness, research, and dissemination of behavioral advice), in association with Boots UK and the Mental Health Foundation (London, England). Our major objectives were to compare and contrast both sleep disturbance and its daytime impact (1) in ID relative to a reference group with no ID, (2) in the ID subtypes (difficulty initiating sleep vs difficulty maintaining sleep vs early morning awakening vs a combination of these symptoms vs nonrestorative sleep), (3) in a comparison of childhood-onset and adult-onset ID, and (4) across clinically comorbid mental health, physical health, and other sleep disorder conditions (ID + mental health condition vs ID + physical health condition vs ID + other sleep disorder vs ID only).

METHOD

Design

We report on 11,129 respondents to the GBSS, an open-access, Web-based survey completed by adults (aged ≥ 18 years) who had a valid postcode and were residents of the United Kingdom. The strengths of this approach include accessibility, ease of use, time-stamping of data acquisition, absence of missing information, and ability to recruit a sizable sample of people meeting ID criteria. Our data are not formally sampled, because it was not our purpose to report population incidence or prevalence figures. Rather, we suggest that the sample is valid in relation to our objectives of profiling the nighttime symptoms and daytime concerns of people who meet ID criteria, with or without comorbid symptoms.

Measures

The GBSS is a brief online survey comprising personal and demographic information; appraisal of sleep pattern, sleep quality, and impact of poor sleep on daytime functioning; use of prescription and over-the-counter sleep aids; items on physical and mental health; and screening questions on sleep disorders other than insomnia. (Illustration of our methods can be viewed at http://www.sleepio.com/research, and the contemporary version of the GBSS is at http://www.greatbritishsleepsurvey.com.) The GBSS incorporated items on sleep and daytime function to permit evaluation against *DSM-5* criteria and to take account of quantitative insomnia criteria including research diagnostic criteria.[13,23] Insomnia disorder cases were defined according to the following criteria:

1. Current complaint of sleep dissatisfaction/concern (ie, scoring ≥ 2 ["somewhat"] on a 0–4 scale when asked, "Over the past month, to what extent has poor sleep troubled you in general?").
2. Complaint comprises 1 of the following:
   - Difficulty initiating sleep ≥ 31 minutes,
   - Difficulty maintaining sleep ≥ 31 minutes (individual is awake for ≥ 31 minutes during the night after initially falling asleep; could include 1 or multiple awakenings),
   - Early morning awakening (final awakening ≥ 31 minutes prior to actual rise time),
   - A combination of at least 2 of these 3 core insomnia symptoms, or
   - Nonrestorative sleep (difficulty initiating and maintaining sleep and early morning awakening ≤ 30 minutes, but all other ID criteria met).
3. Failure to endorse "very good" or "good" sleep quality (ie, required to score ≥ 2 ["average"] on a 0–4 scale when asked, "Over the past month, how would you rate your sleep quality?").
4. Complaint is associated with significant sleep-related daytime effects (ie, scoring ≥ 2 ["somewhat"] on a 0–4 scale; 0 = not at all affected, 4 = very much affected) on at least 1 of 6 domains: energy, daytime sleepiness, cognitive impairment, mood disturbance, impaired work functioning, impaired relationship functioning.
5. Sleep difficulty is reported to be affecting the person ≥ 3 nights per week.
6. Sleep difficulty has been occurring for ≥ 3 months.

The GBSS also incorporated the Sleep Disorders Screening Questionnaire, a published clinical tool for conservatively identifying possible cases of narcolepsy, obstructive sleep apnea, restless legs syndrome/periodic limb movements in sleep, circadian rhythm sleep disorder, and parasomnia[24] (see algorithm at http://www.sleepio.com/research). The GBSS inquired about health status by means of 2 items: "For my age I believe that my physical health is . . ." and "For my age I believe that my mental health is . . .," both rated on a 5-point Likert scale (0 = very good, 1 = good, 2 = average, 3 = poor, 4 = very poor). For this analysis, poor physical health and poor mental health were defined by a score ≥ 3 on the respective ratings.

Table 1. Comparison of Respondents With and Without Insomnia Disorder in Relation to Demographic and Sleep Variables

Variable	Insomnia Disorder (n = 5,083)	No Insomnia Disorder (n = 5,542)	Total Sample (N = 10,625)
Gender, % male/female	25.3/74.7*	30.8/69.2	28.2/71.8
Age, mean (SD), y	41.3 (14.8)*	37.6 (14.0)	39.4 (14.5)
Index of multiple deprivation score, mean (SD)[a]	20.1 (14.3)	20.3 (14.5)	20.2 (14.4)
Physical health score, mean (SD)[b]	1.72 (0.95)*	1.43 (0.89)	1.57 (0.93)
Mental health score, mean (SD)[b]	1.82 (1.08)*	1.29 (0.99)	1.54 (1.07)
SCI score, mean (SD)[c]	3.02 (1.25)*	6.95 (1.82)	5.07 (2.52)
Taking prescribed sleeping pills, %	12.0*	2.8	7.2
Taking over-the-counter sleep remedies, %	24.3*	9.8	16.7
Insomnia duration, % reporting			
< 12 mo	17.0		
1–5 y	38.0		
6–10 y	17.0		
≥ 11 y	28.0		

[a]A proxy for socioeconomic status, determined through residential postcode. Based on English residents only.
[b]Lower scores indicate better perceived health: 0 = very good, 4 = very poor.
[c]Scale of 0 to 10; higher values reflect better overall sleep quality.
*$P < .0001$ for comparisons between respondents with and without insomnia disorder.
Abbreviation: SCI = Sleep Condition Indicator.

Items from the GBSS were also used to calculate the Sleep Condition Indicator (SCI; 0–10 range), on which higher values reflect better overall sleep quality. The SCI has excellent sensitivity and specificity, high internal consistency reliability, and sensitivity to change following cognitive-behavioral therapy.[25] The SCI also correlates with other standard measures of sleep quality (Pittsburgh Sleep Quality Index: $r = 0.78$, n = 256; Insomnia Severity Index: $r = 0.79$, n = 256).[26]

Statistical Analysis

Potential differences associated with expressions of the independent variable (sleep status) on the primary dependent variables of interest (6 daytime domains) were evaluated using multivariate analysis of variance (MANOVA), controlling for age and gender. Significant multivariate statistics were followed up through examination of univariate *F* tests for each domain and were pursued by independent *t* tests to determine order effects in terms of severity of daytime impact. Comparisons were 2-sided, with $P < .05$ considered to indicate statistical significance. When appropriate, to control for multiple comparisons within and between subjects, a per family error rate was adopted (.05/*n* of comparisons). Relative between-group effect sizes, expressed as Cohen *d* ($M_1 - M_2 / \delta_{pooled}$),[27] were applied to estimate and to compare the magnitude of observed effects.

RESULTS

Characteristics of Participants With Versus Without Insomnia Disorder

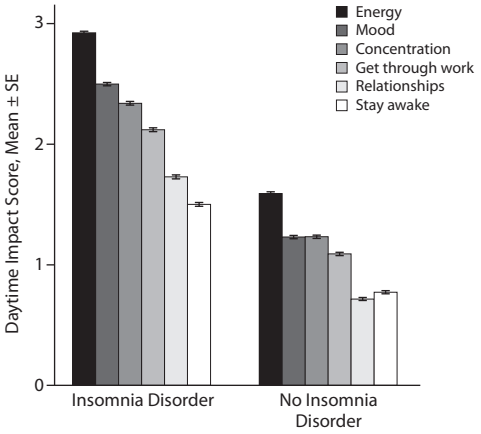
A total of 11,129 people (8,044 [72.3%] female; mean age = 39 years; range, 18–93 years) completed the survey (March 2010–April 2011). With the application of *DSM-5* criteria, 5,083 participants (45.7%) screened as having possible ID (ID group), and 5,542 did not have ID (NO-ID group) (49.8%; Table 1). A small number met insomnia criteria with duration ≤ 3 months, reflecting acute insomnia (sleep disturbance duration < 1 month; n = 131, 1.2%) or subacute insomnia (sleep disturbance duration 1–3 months; n = 373, 3.4%). These individuals were excluded, and thus the total number included in the analysis was 10,625. For those with ID, their sleep problem was typically chronic, with 83% having had insomnia for over 1 year and 45% having had it for ≥ 6 years.

A higher proportion of the ID group, relative to the NO-ID group, was female (75% vs 69%; $\chi^2 = 40.5$, $P < .0001$). The ID group was also older ($t_{10413.30} = 13.44$, $P < .0001$) and had poorer mental health ($t_{10313.16} = 26.14$, $P < .0001$) and physical health ($t_{10623} = 16.15$, $P < .0001$). We determined index of multiple deprivation (IMD) scores, a proxy for socioeconomic status, through residential postcodes (IMD analysis included English residents only). As the majority of our respondents were from England (n = 8,235), we compared IMD scores between those with insomnia (n = 3,991) and those without insomnia (n = 4,244), finding no significant difference ($t_{8233} = 0.724$, $P = .469$). Mean IMD values for our available sample (20.2, SD = 14.4) were similar to the national average (21.7, SD = 15.5).[28] Confirmation of sleep status allocations may be drawn from the finding that SCI scores for the NO-ID group were significantly higher ($t_{9862.89} = 130.46$, $P < .0001$), more than twice those of the ID group (see Table 1).

Daytime Impact of Insomnia Disorder Relative to No Insomnia Disorder

The ID and NO-ID groups were compared across the 6 *DSM-5* domains of daytime functioning. Since, by definition, the NO-ID group did not experience poor sleep on a regular basis, questions for these participants reflected the level of daytime impairment they experienced on their (occasional) nights of poor sleep. Formal analysis, with gender and age as covariates, produced an omnibus multivariate effect ($F_{6,10616} = 1035.04$, $P < .0001$) and significant univariate effects for all domains (all $P < .0001$), with the ID group reporting greater impairment (Figure 1). Relative between-group effect sizes were strongest for energy ($d = 1.30$), mood ($d = 1.24$), and concentration ($d = 1.05$) and remained large for relationships ($d = 0.96$) and getting through work ($d = 0.94$). Ability to stay awake during the day produced a smaller, though still moderate to large, between-group effect size ($d = 0.68$). This relative ordering of mean daytime impact for the ID group was paralleled by the proportions of participants who reported being "very much affected" on energy (30.7% of the ID sample), mood (18.9%), concentration (16.9%), getting

Figure 1. Comparison of Respondents With and Without Insomnia Disorder in Relation to Negative Impact on the 6 *DSM-5* Areas of Daytime Dysfunction[a]



[a]Higher scores reflect greater negative impact.

through work (14.6%), relationships (8.7%), and ability to stay awake (7.2%).

Daytime Impact Across Insomnia Disorder Subtypes

The most common subtype was a combination of the 3 core symptoms (MIXED; 61.3%), followed by difficulty maintaining sleep (DMS; 12.7%), difficulty initiating sleep (DIS; 12.4%), nonrestorative sleep (NRS; 9.5%), and early morning awakening (EMA; 4.2%) (Table 2). The MIXED group comprised the following symptom combinations: DMS + EMA (9.2% of total ID group), DIS + DMS (24.4%), DIS + EMA (6.7%), and DIS + DMS + EMA (21.0%). Subtype differences were found for gender distribution ($\chi^2 = 16.23$, $P < .01$), age ($F_{4,5078} = 87.35$, $P < .0001$), and, controlling for age and gender, self-reported mental health ($F_{4,5076} = 10.15$, $P < .0001$) and physical health ($F_{4,5076} = 7.43$, $P < .0001$). For mental health, the MIXED group was more impaired relative to the DMS group, and for physical health, the DMS group was more impaired relative to the EMA, MIXED, and NRS groups. There were also subtype differences with respect to the SCI ($F_{4,5076} = 525.9$, $P < .0001$) and prescribed sleeping pill use ($\chi^2 = 62.63$, $P < .0001$), with the MIXED group reporting the poorest overall sleep quality and being most likely to be taking prescribed sleeping pills.

In relation to the nature and magnitude of daytime impairment, formal analysis, with gender and age as covariates, produced an omnibus multivariate effect ($F_{24,17691.82} = 4.61$, $P < .0001$), and subsequent univariate effects were found for all 6 domains ($P < .05$ for staying awake and $P < .0001$ for the other 5 domains). When the Bonferroni comparison method for multiple testing was applied, those with the MIXED subtype reported greater daytime impairment relative to the other subtypes, particularly for mood, concentration, and getting through work (see Table 2). The magnitude of these differences was small (Cohen *d* range, 0.10–0.23). There were few subtype differences for problems staying awake, with the exception that the NRS group was significantly more impaired relative to the DIS group.

Daytime Impact of Insomnia Disorder Comorbid With Mental or Physical Health Problems or Additional Sleep-Related Disturbance

We investigated daytime impairment in relation to whether ID presented on its own (ID-Alone; n = 1,884, 37.1%) or with poor physical health (ID + PH; n = 166, 3.3%), poor mental health (ID + MH; n = 384, 7.6%), or another sleep disorder (ID + SLD; n = 1,691, 33.3%). Approximately 22% of participants (n = 1,138) reported ID in the presence of at least 2 (of the possible 3) comorbid presentations, reflected in the following groups: ID + PH + MH (n = 148, 2.9%), ID + MH + SLD (n = 510, 10%), ID + PH + SLD (n = 300, 5.9%). No participants reported having ID plus 3 comorbidities (ie, ID + MH + PH + SLD). For the purpose of the present analysis, we focused on daytime impairment across 4 discrete groups, ID-Alone, ID + PH, ID + MH, and ID + SLD, reflecting *DSM-5* proposals for recording possible comorbidities.

MANOVA revealed a significant main effect of comorbidity group ($F_{18,11636.63} = 18.9$, $P < .0001$), and univariate effects were found for all daytime domains ($P < .0001$; Table 3). Respondents with ID + MH were found to have greater sleep-related daytime impairment in relation to mood, concentration, and getting through work relative to every other group and reported enhanced levels of impairment for relationship functioning compared to those in the ID-Alone and ID + SLD groups. With respect to energy, the ID + MH, ID + PH, and ID + SLD groups all tended to have greater impairments relative to the ID-Alone group, and, with respect to ability to stay awake, the ID + SLD group exhibited the greatest impairment relative to the other 3 groups. The ID + MH group also had the poorest SCI score and reported greater usage of sleeping pills. Effect sizes for group differences, where the ID + MH group evidenced the greatest impairment, ranged from $d = 0.15–0.65$, with larger effects typically reflecting comparisons with the ID-Alone group.

Daytime Impact of Childhood-Onset Versus Adult-Onset Insomnia Disorder

Finally, the GBSS included the simple question, "Did you sleep well as a child?" (yes/no) to estimate idiopathic insomnia (consistent with criteria used in the *International Classification of Sleep Disorders*, second edition[29]). This allowed us to investigate the daytime impact of childhood-onset ID (n = 1,230; 24.2%) relative to adult-onset ID (n = 3,853; 75.8%, Table 4). Those who slept poorly during childhood were more likely to be younger ($t_{2193.34} = 10.97$, $P < .0001$) and female ($\chi^2 = 12.52$, $P < .0001$) and have poorer sleep quality (SCI: $t_{5081} = 5.82$, $P < .0001$). In addition, those reporting childhood onset had poorer mental health ($F_{1,5079} = 29.53$, $P < .0001$) and were more likely to be taking sleep-promoting hypnotics ($\chi^2 = 4.98$, $P < .05$) and over-the-counter remedies ($\chi^2 = 7.21$, $P < .01$). MANOVA revealed a significant main effect of group ($F_{6,5074} = 2.41$, $P < .05$). Significant univariate effects were found for 4 domains: energy ($P < .05$), mood,

Table 2. Comparison of Insomnia Disorder Subtypes in Relation to Demographic Variables and Sleep-Related Daytime Impairment

Variable	Difficulty Initiating Sleep (n = 632; 12.4%)	Difficulty Maintaining Sleep (n = 644; 12.7%)	MIXED[a] (n = 3,114; 61.3%)	Early Morning Awakening (n = 212; 4.2%)	Nonrestorative Sleep (n = 481; 9.5%)	Significant Contrasts With Bonferroni Correction
Gender, % male/female	73.4/26.6	73.8/26.2	76.4/23.6	71.2/28.2	68.6/31.4	
Age, mean (SD), y	32.3 (12.4)	46.2 (12.6)	42.4 (15.2)	40.9 (14.5)	39.7 (12.9)	
SCI score, mean (SE)[b]	3.60 (0.04)	3.38 (0.04)	2.53 (0.02)	4.4 (0.07)	4.4 (0.05)	
Physical health score, mean (SE)[c]	1.71 (0.04)	1.57 (0.04)	1.73 (0.02)	1.91 (0.07)	1.81 (0.04)	DMS > MIXED, EMA, NRS
Mental health score, mean (SE)[c]	1.75 (0.04)	1.61 (0.04)	1.88 (0.02)	1.82 (0.07)	1.77 (0.05)	MIXED > DMS
Domain of daytime functioning score, adjusted mean (SE)						
Mood	2.38 (0.04)	2.40 (0.04)	2.58 (0.02)	2.35 (0.07)	2.30 (0.05)	MIXED > DIS, DMS, EMA, NRS
Energy	2.83 (0.04)	2.85 (0.04)	2.97 (0.02)	2.90 (0.06)	2.88 (0.04)	MIXED > DIS, DMS
Relationships	1.57 (0.05)	1.72 (0.05)	1.79 (0.02)	1.63 (0.08)	1.57 (0.05)	MIXED > DIS, NRS
Staying awake	1.38 (0.05)	1.49 (0.05)	1.51 (0.02)	1.48 (0.08)	1.62 (0.05)	NRS > DIS
Concentration	2.26 (0.04)	2.29 (0.04)	2.40 (0.02)	2.15 (0.07)	2.19 (0.05)	MIXED > DIS, EMA, NRS
Getting through work	2.07 (0.05)	2.02 (0.05)	2.18 (0.02)	1.94 (0.08)	2.00 (0.05)	MIXED > DMS, EMA, NRS
Taking prescribed sleeping pills, %	8.2	9.0	14.8	5.2	6.0	

[a]Respondent had more than 1 of the core symptoms (difficulty initiating sleep, difficulty maintaining sleep, early morning awakening).
[b]Scale of 0 to 10; higher values reflect better overall sleep quality.
[c]Lower scores indicate better perceived health: 0 = very good, 4 = very poor.
Abbreviations: DIS = difficulty initiating sleep, DMS = difficulty maintaining sleep, EMA = early morning awakening, NRS = nonrestorative sleep, SCI = Sleep Condition Indicator.

Table 3. Comparison of Insomnia Disorder (ID) Presentations in Relation to Demographic Variables and Sleep-Related Daytime Impairment

Variable	ID + Mental Health Condition (n = 384)	ID + Other Sleep Disorder (n = 1,691)	ID + Physical Health Condition (n = 166)	ID Alone (n = 1,884)	Significant Contrasts With Bonferroni Correction
Gender, % male/female	23.4/76.6	29.4/70.6	18.1/81.9	22.7/77.3	
Age, mean (SD), y	37.4 (13.7)	40.6 (15.1)	41.9 (15.7)	44.2 (14.3)	
SCI score[a]					
Mean (SD)	2.75 (1.28)	3.07 (1.28)	3.05 (1.24)	3.22 (1.18)	
Mean (SE)	2.72 (0.06)	3.05 (0.03)	3.06 (1.0)	3.24 (0.03)	
Domain of daytime functioning score, adjusted mean (SE)					
Mood	2.86 (0.05)	2.46 (0.02)	2.31 (0.08)	2.30 (0.02)	ID + MH > ID + SLD, ID + PH, ID ID + SLD > ID
Energy	3.02 (0.05)	2.95 (0.02)	3.02 (0.07)	2.72 (0.02)	ID + MH, ID + PH, ID + SLD > ID
Relationships	1.92 (0.06)	1.73 (0.03)	1.75 (0.09)	1.55 (0.03)	ID + MH > ID + SLD, ID ID + SLD > ID
Staying awake	1.36 (0.06)	1.69 (0.03)	1.38 (0.09)	1.17 (0.03)	ID + SLD > ID + MH, ID + PH, ID ID + MH > ID
Concentration	2.57 (0.05)	2.34 (0.03)	2.20 (0.08)	2.12 (0.02)	ID + MH > ID + SLD, ID + PH, ID ID + SLD > ID
Getting through work	2.33 (0.06)	2.14 (0.03)	1.97 (0.09)	1.88 (0.03)	ID + MH > ID + SLD, ID + PH, ID ID + SLD > ID, ID + PH
Taking prescribed sleeping pills, %	18.0	10.6	10.8	10.9	

[a]Scale of 0 to 10; higher values reflect better overall sleep quality.
Abbreviations: MH = mental health condition, PH = physical health condition, SCI = Sleep Condition Indicator, SLD = sleep disorder.

concentration, and getting through work (all $P < .01$), with the childhood-onset group evidencing greater impairment. Between-group effects were small (range of *d* values, 0.12–0.24).

DISCUSSION

Our objective was to understand how daytime symptom patterns associate with nighttime sleep in *DSM-5* insomnia disorder.

First, our findings validate the *DSM-5* domains because the patterning of impact mirrored that reported by people in the group without ID in relation to the (infrequent) nights when the latter group does not sleep well (Figure 1). Between-group effect sizes for this comparison were large for energy, mood, concentration, relationships, and work functioning (range of *d* values, 0.94–1.30), with daytime sleepiness the least affected area, though still evidencing a moderate effect ($d = 0.68$). These results are consistent with other research suggesting that impairment of energy, mood, and cognition is characteristic of insomnia,[30–32] whereas daytime sleepiness, while elevated relative to normal sleepers, is less so.[33,34]

Second, we observed differences in symptomatology associated with the presenting subtype. The group with multiple core symptoms exhibited the greatest impairment,

Table 4. Comparison of Childhood- Versus Adulthood-Onset Insomnia in Relation to Demographic Variables and Sleep-Related Daytime Impairment

Variable	Sleep Problems in Childhood (n = 1,230; 24.2%)	No Sleep Problems in Childhood (n = 3,853; 75.8%)
Gender, % male/female	21.5/78.5**	26.5/73.5
Age, mean (SD), y	37.3 (13.9)**	42.6 (14.8)
Physical health score, mean (SE)[a]	1.76 (0.03)	1.71 (0.02)
Mental health score, mean (SE)[a]	1.96 (0.03)**	1.77 (0.02)
SCI score, mean (SE)[b]	2.82 (0.04)**	3.09 (0.02)
Taking prescribed sleeping pills, %	13.8*	11.4
Taking over-the-counter sleep remedies, %	27.2**	23.4
Domain of daytime functioning score, adjusted mean (SE)		
Mood	2.57 (0.03)**	2.48 (0.02)
Energy	2.98 (0.03)*	2.91 (0.02)
Relationships	1.78 (0.03)	1.71 (0.02)
Staying awake	1.52 (0.03)	1.50 (0.02)
Concentration	2.42 (0.03)**	2.31 (0.02)
Getting through work	2.20 (0.03)**	2.10 (0.02)

[a]Lower scores indicate better perceived health: 0 = very good, 4 = very poor.
[b]Scale of 0 to 10; higher values reflect better overall sleep quality.
*$P < .05$, **$P < .01$ for group comparisons.
Abbreviation: SCI = Sleep Condition Indicator.

most pronounced for mood. In the group with multiple symptoms, concentration was also more impaired relative to the groups with difficulty initiating sleep, early morning awakening, and nonrestorative sleep, and getting through work was more impaired relative to the groups with difficulty maintaining sleep, early morning awakening, and nonrestorative sleep. These results were statistically robust, though small in magnitude and broadly comparable to those of Léger et al.[15] Our data also indicate that nonrestorative sleep impacts functioning to a similar degree as difficulty initiating sleep, difficulty maintaining sleep, and early morning awakening, in keeping with emerging epidemiologic and experimental literature.[16,17,35]

Third, investigation of comorbid conditions revealed that in 3 domains (concentration, mood, and getting though work) the group with ID and a mental health condition reported the greatest impairment, and this group was 70% more likely to be taking sleep-promoting hypnotics. Unsurprisingly, those with ID and another sleep disorder had the greatest difficulty with maintaining wakefulness. Participants who had ID alone tended to be the least impaired, reflecting research on health-related quality of life showing that controlling for comorbidities slightly attenuates the next-day impact of poor sleep.[14] Nevertheless, robust between-group effects were evident even when we compared the group with ID alone and the group without ID (n = 1,884 vs n = 5,542, supplementary analysis: large effects for all domains [range of *d* values, 0.72–1.09] except sleepiness [$d = 0.38$]).

Finally, we found that those who had slept poorly as children (one-quarter of the ID group) had poorer sleep and mental health and greater deficits in energy, mood, concentration, and ability to get through their work. Sánchez-Ortuño et al[22] reported that such idiopathic insomnia and insomnia with mental health conditions clustered together and were associated with mood disturbance. Perhaps the link between childhood-onset insomnia and affective impairment supports an underlying, possibly genetic, vulnerability to both sleep disturbance and depression.[37]

The clinical importance of daytime concerns as an integral component of ID should not be underestimated. We found substantial daytime effects for people with all insomnia subtypes when compared with normal sleepers. It seems appropriate then to emphasize that *DSM-5* ID can be characterized by poorer sleep *and* poorer daytime well-being. It seems likely that the combination of these experiences will drive clinical complaint.[37] This interaction requires greater attention in practice, if we are to properly treat ID.[14,38] Our data suggest that this clinical attention may be particularly important for patients presenting a mixed subtype of insomnia, those with co-occurring poor mental health, and those with an early history of sleep disturbance. A therapeutic focus on how to cope with and minimize daytime symptoms could enhance "traditional" cognitive-behavioral therapy for insomnia.[39]

The strength of this study lies in the application of *DSM-5* criteria to a sizable population. We did not have a validation sample, using gold-standard clinical interviews, and our survey method is likely to have introduced error. Our screening of physical and mental health and our definition of childhood insomnia were self-reported and based on single items, so we urge caution in interpreting the results. Further work is required using face-to-face clinical evaluation and/or more comprehensive self-report methodology to improve the characterization of respondents' mental and physical health status. Our approach to data analysis intentionally reflected a categorical/diagnostic view of ID, typical of disease classification nosologies and of clinical practice. Real-world evaluations of this kind are essential to consider the *DSM-5* ID criteria. Nevertheless, we recognize that objective validation studies on nighttime and daytime symptoms are important. A recent report showed that slow-wave sleep was reduced in those with multiple core symptoms and those with difficulty maintaining sleep,[16] so it is possible that slow-wave sleep has a mediating effect on daytime performance.[40] Thus, there is a clear need for further work to characterize interactions among objectively determined sleep parameters, health status (including medication influences), and daytime functioning. Multivariate modeling would also help elucidate associations between sleep and daytime well-being and possible intermediate variables. One example would be that the impact of hypnotics on daytime functioning is well known,[41] and in our study "higher risk" groups were more likely to endorse taking prescription sleep medication. We cannot, therefore, exclude the possibility that greater levels

of daytime symptoms were in part an artifact of such other factors.

Finally, we should also mention that, when the study was conducted, we included the 6 daytime domains that were listed on the *DSM-5* Web site at that time (ie, the version dated June 2, 2010). We acknowledge that since then there have been some changes, including the addition of a domain relating to behavioral problems (eg, hyperactivity, impulsivity, aggression). This latter domain, however, may refer more to sleep problems in children and young people rather than adults.

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Potential conflicts of interest: **Dr Espie** is Clinical and Scientific Director of Sleepio Ltd and developed the Web platform for the Great British Sleep Survey, but has not received income from Sleepio Ltd. **Mr Hames** is Managing Director and CEO of Sleepio Ltd and has received a salary from the company. **Drs Kyle**, **Cyhlarova**, and **Benzeval** report no potential conflict of interest.
Funding/support: No direct funding was provided for this research.

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