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Publication Date

2017-04-01

DOI

10.1016/j.jocrd.2017.01.006

Peer reviewed

Published in final edited form as:

J Obsessive Compuls Relat Disord. 2017 April ; 13: 49–57. doi:10.1016/j.jocrd.2017.01.006.

Sleep functioning in adults with trichotillomania (hair-pulling disorder), excoriation (skin-picking) disorder, and a non-affected comparison sample

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Abstract

The present study assessed sleep functioning in Trichotillomania (TTM; Hair-Pulling Disorder) and Excoriation (Skin-Picking) Disorder (ExD), and a non-affected comparison group, and examined the prevalence and correlates of bedtime and sleep-related hair pulling and skin picking. Participants were adult internet survey respondents, who met diagnostic criteria for TTM (*N*=259), ExD (*N*=182), or did not meet criteria for these disorders (*N*=148). Individuals with TTM and ExD endorsed significantly greater sleep disturbance relative to the comparison group, even after controlling for internalizing (anxiety and depression) symptoms. Hair pulling and skin picking severity were not significantly correlated with sleep disturbance after controlling for internalizing symptoms. Pulling and picking during sleep occurred at rates of 13% and 27%, respectively. Picking severity, anxiety and depressive symptoms, and sleep disturbance were significantly increased in those who engaged in picking during sleep relative to those who did not endorse this behavior. No significant differences were found between those endorsing pulling during sleep and those not endorsing this on demographic, clinical, or sleep variables. The present study highlights the potential role of sleep disturbance in TTM and ExD, and the need for further research in this area.

Keywords

Trichotillomania; Excoriation disorder; Sleep; Internet survey

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Author note

Emily Ricketts, Ph.D., Ivar Snorrason, M.A., Michelle Rozenman, Ph.D., Christopher Colwell, Ph.D., and John Piacentini, Ph.D. disclose no conflicts of interest. James T. McCracken, M.D. is a consultant for Think Now, Inc., receives honoraria from Alcobra Pharmaceuticals for services as a data and safety monitoring board chair, serves as a consultant for Smartanalyst, Inc., and has received donated drug supplies for research from AstraZeneca. These disclosures are unrelated to the current manuscript submission.

1. Introduction

Trichotillomania (TTM; Hair-Pulling Disorder), and Excoriation (Skin-Picking) Disorder (ExD) are body-focused repetitive behavior disorders (BFRBDs) characterized by recurrent hair pulling and skin picking, resulting in hair loss/thinning, and tissue damage, respectively (American Psychiatric Association, 2013). The prevalence of TTM and ExD ranges from 0.6% to 3.9% (Christenson, 1991b; Duke, Bodzin, Tavares, Geffken, & Storch, 2009; Grant, Levine, Kim, & Potenza, 2005; Grant, Williams, & Potenza, 2007; King, Zohar, & Ratzoni, 1995) and 0.2–12%, (Grant et al., 2007; Hayes, Storch, & Berlanga, 2009; Keuthen, Deckersbach, & Wilhelm, 2000; Keuthen, Koran, Aboujaoude, Large, & Serpe, 2010) respectively. TTM and ExD are thought to share underlying illness features (i.e., diagnostic validators, genetic etiology, etc. Monzani, Rijsdijk, Harris, and Mataix-Cols, 2014; Snorrason, Belleau et al. 2012). The DSM-5 diagnostic criteria for TTM include repeated pulling out of one's hair causing hair loss; repeated attempts to stop or decrease pulling; significant distress or impairment related to pulling; and symptoms not better accounted for by a medical condition, other psychiatric condition, or the effects of substances. (American Psychiatric Association, 2013). In parallel, and reflecting the similarities to TTM, criteria for ExD are repeated picking (or scratching, digging, etc.) at one's skin leading to tissue damage; repeated efforts to reduce or stop the behavior; associated impairment or distress; and symptoms not due to a medical condition, other psychiatric disorder or the effects of substances. (American Psychiatric Association, 2013). Both disorders can inflict an immense personal toll on individuals, including damaging physical effects (i.e., hair loss, scars, etc.), emotional distress (i.e., guilt, shame, embarrassment), social avoidance, or isolation, and comorbid depression and anxiety (Tucker, Woods, Flessner, Franklin, and Franklin, 2011; Woods, Flessner, and Franklin, 2006).

Clinical case reports suggest a minority of individuals with TTM or ExD engage in hair pulling or skin picking during sleep (Murphy, Redenius, O'Neill, & Zallek, 2007; Sack & Hanifin, 2010). However, little empirical data are available about sleep-related pulling and picking or the relationship between sleep quality and BFRBDs. ExD patients presenting to a dermatology clinic reported significantly lower sleep quality relative to other dermatology patients and healthy controls; however ExD patients also endorsed higher levels of anxiety and perceived stress, which may have contributed to problems with sleep in this sample (Singareddy, Moin, Spurlock, Merritt-Davis, & Uhde, 2003). Nevertheless, an understanding of the relationships between internalizing symptoms, commonly co-occurring with BFRBDs, sleep functioning, and BFRBD symptoms remains unclear.

Furthermore, despite a few case reports of patients who pull and pick during sleep, we know little about the prevalence of these behaviors. Findings from a survey of dermatologists provide some clues, with results showing 11% had treated at least one patient with sleep-isolated hair pulling, and 20% had suspected that a patient pulled during sleep. (Murphy et al., 2007) Hair pulling during sleep has been reported in several cases of young children – all with a history of pulling in other contexts as well (Adam & Kashani, 1990; Altman, Grahs, & Friman, 1982; De Luca & Holborn, 1984) – however we know little about the associated clinical features. In a case history of an adult TTM patient with hair pulling during sleep, video polysomnography revealed pulling occurred during periods of EEG wakefulness and

was consistent with a diagnosis of Sleep-Related Dissociative Disorder (Angulo-Franco, Bush-Martínez, Nenclares-Portocarrero, & Jiménez-Genchi, 2015). Additionally, two separate case reports featuring video-based and standard polysomnography, respectively, describe sleep-isolated hair pulling in an adult (Murphy, Valerio, & Zallek, 2006) and a child (Görker, Karasalihoğlu, & Öztürk, 2010) during non-rapid eye movement (NREM) sleep and thought to constitute a NREM sleep parasomnia. Other case reports featuring polysomnography methods in three adults each suggest sleep-isolated nocturnal scratching (not associated with dermatological or other conditions) may represent a parasomnia (Nigam, Riaz, Hershner, Goldstein, & Chervin, 2016) or NREM sleep-related parasomnia more specifically. (Schenck and Mahowald, 2007). These case summaries highlight the contributions of sleep architecture to BFRB expression occurring during sleep. Most of the patients described had a history of other sleep difficulties (e.g., obstructive sleep apnea, other parasomnias, insomnia); and a history of depression was reported in a few cases. However, we lack comprehensive understanding of the associated clinical characteristics of pulling and picking occurring during sleep.

As studies of sleep in BFRBs to date have featured small sample sizes (n =30; Singareddy et al., 2003) or single cases, and lacked comparisons of sleep patterns in both TTM and ExD relative to non-affected individuals, the present study had several objectives. Specifically, this study aimed to (1) compare sleep functioning in large samples of adults with TTM and ExD relative to non-affected controls, (2) assess the relationship between hair pulling and skin picking severity and subtype (referring to two evolving independent constructs: the degree to which hair pulling and skin picking are performed with awareness or intentionally, and the degree to which hair pulling and picking are emotion or urge-driven; Flessner, Woods, Franklin, Cashin, & Keuthen, 2008; Keuthen, Tung, & Woods, 2015) and sleep functioning, and (3) explore rates and correlates of hair pulling and skin picking in bed before falling asleep and during sleep. An enhanced understanding of these relationships may help to inform assessment and treatment of BFRBDs.

2. Materials and methods

2.1. Participants

Participants were adults with TTM, ExD, or healthy comparison subjects who participated in an internet survey on sleep quality. Participants with TTM were recruited via the Trichotillomania Learning Center [TLC; (www.trich.org) (now named TLC Foundation for Body-Focused Repetitive Behaviors (www.bfrb.org)], TrichStop.com (www.trichstop.com), and Trichotillomania Friends: A Yahoo group (https://groups.yahoo.com/neo/groups/Trichotillomania-friends/info). Participants with ExD were recruited through TLC, SkinPick.com (http://www.skinpick.com/stop-picking-my-skin), Stoppickingonme.com (www.stoppickingonme.com), and Pickaderms: A Yahoo group (https://groups.yahoo.com/neo/groups/pickaderms/info).

Recruitment lasted for a 4-month period from May 2015 to August 2015. Healthy comparison subjects were recruited via Amazon Mechanical Turk (AMT) (https://www.mturk.com/mturk/welcome), an online platform in which individuals can receive small monetary compensation for completion of tasks and surveys, during a 7-day period from

May 2015 to June 2015. Use of AMT for general population data acquisition has demonstrated sample heterogeneity, responses comparable to other (including laboratory-based) samples, and high test-retest reliability (Buhrmester, Kwang, & Gosling, 2011; Goodman, Cryder, & Cheema, 2013; Holden, Dennie, & Hicks, 2013; Johnson & Borden, 2012; Mason & Suri, 2012).

3. Measures

3.1. Demographics and medical history

The surveys included items assessing key demographic information, including age, ethnicity, educational level, household income, marital status. Participants also provided information on medical and psychiatric history, including past psychotropic and sleep medications, and past psychiatric diagnosis by a health professional. Participants from the comparison sample with positive psychiatric or psychotropic medication history were removed from the final sample (see Method).

3.2. Bedtime and sleep-related hair pulling and skin picking questions

The TTM and ExD participants were administered questions regarding the frequency and context of hair pulling and skin picking at bedtime; the frequency, context, and reason for knowledge of hair pulling and skin picking during sleep; and the percentage of total hair pulling and or skin picking comprised by pulling or picking during sleep. The TTM survey featured questions primarily in relation to hair pulling and the ExD survey featured the same items with respect to skin picking. Items regarding context and evidence of hair pulling and skin picking were developed through a review of the literature on BFRBs with respect to contextual cues, and sleep, in addition to a review of anecdotal report from individuals who engage in sleep-related BFRBs found through internet community question and answer forums. The first author used this information to formulate questions and answer choices, with back and forth review and editing by experts, (third and last authors). For specific wording of questions see Results.

3.3. Pittsburgh Sleep Quality Index (PSQI)

The PSQI (Buhrmester et al., 2011; Goodman et al., 2013; Holden et al., 2013; Johnson & Borden, 2012; Mason & Suri, 2012) is a 19-item self-report measure of sleep quality and disturbance during the past month. The scale yields an overall total score and seven subtotal scores for subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The PSQI displays adequate to high test-retest reliability, (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) high internal consistency, and adequate to good convergent, divergent, and concurrent validity (Buysse et al., 1989; Carpenter and Andrykowski, 1998).

3.4. Massachusetts General Hospital Hairpulling Scale (MGH-HPS)

The MGH-HPS (Keuthen, O'Sullivan, & Ricciardi, 1995) assesses hair pulling urge frequency, intensity, and controllability, hair pulling frequency, resistance, and controllability, and associated distress during the prior week. It consists of seven items, each scored on a 5-point scale, with ratings of 0–4. The total score ranges from 0 to 28, with

higher scores indicating greater severity. Findings from an internet sample yield a two-factor solution for the measure, including, severity, and resistance and control (Keuthen et al., 2007). The scale has excellent test-retest reliability, good convergent and divergent validity, and displays sensitivity in reflecting symptom change (O'Sullivan, Keuthen, & Hayday, 1995).

3.5. Milwaukee Inventory for Subtypes of Trichotillomania-Adult Version, Revised (MIST-A-R)

The MIST-A-R (Keuthen et al., 2015) is a 13-item self-report measure assessing hair pulling subtypes. It was adapted from the MIST-A, which was developed in an internet sample (Flessner et al., 2008) It features two scales: an 8-item intention scale assessing degree to which hair pulling is performed with behavioral intention, and a 5-item emotion scale assessing the degree to which hair pulling is performed in relation to emotional triggers or an urge to pull. The items are rated from 0 to 9, with intention scale scores ranging from 0 to 72 and emotion scale scores ranging from 0 to 45. The MIST-A-R intention and emotion scales have good construct and discriminant validity (Keuthen et al., 2015)

Skin Picking Scale-Revised (SPS-R). The SPS-R (Snorrason & Olafsson, 2012) is an 8-item measure of skin picking severity in the past week, developed using an internet sample. It includes an overall total score and 4-item severity and impact subtotals. Items are rated using a 0-to-4 likert scale, with subtotals each ranging from 0 to 16, and the total score ranging from 0 to 32. Higher ratings are indicative of greater skin picking severity. The SPS-R demonstrates high internal consistency, robust factor structure, and good convergent and discriminant validity (Snorrason and Olafsson, 2012).

3.6. Milwaukee Inventory for the Dimensions of Skin Picking (MIDAS)

The MIDAS (Walther, Flessner, Conelea, & Woods, 2009) is a 12-item measure assessing the degree to which skin picking is automatic (occurring with little awareness), and focused (occurring with full awareness, often in response to an urge or negative emotions). It features separate 6-item automatic and focused subscales, with items rated on a 0-to-4 likert scale, and scores for each ranging from 6 to 30. The MIDAS displays good convergent and divergent validity and adequate internal consistency in an internet sample (Walther et al., 2009).

3.7. Brief Symptom Inventory (BSI)

The BSI (Derogatis & Melisaratos, 1983) is a 53-item self-report measure of severity of symptoms of psychopathology. It includes subscales assessing symptoms of somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, phobia, phobia, paranoia, and psychoticism. The BSI has high internal consistency, and excellent test-retest reliability (Derogatis & Melisaratos, 1983). Raw scores were converted to gender-and sample-based (non-psychiatric for control group, psychiatric outpatient for TTM and ExD groups) t-scores using the standardized published norms (Degoratis & Spencer, 1982).

4. Procedure

4.1. TTM and ExD survey procedure

Individuals recruited through BFRB websites were presented with a description of and link to the survey, which was hosted on Survey Monkey Enterprise (www.surveymonkey.com). Participants read a web-based IRB-approved form describing the study and were instructed to complete a brief study eligibility check prior to indicating study agreement. The eligibility check assessed for English fluency, an age of 18 or older, and the presence of recurrent hair pulling or skin picking. Those who passed the eligibility screen were informed they were eligible for the 30-min survey and were asked to use check boxes to indicate whether or not they had read the study consent form, met eligibility criteria and agreed to participate in the survey. Those who agreed continued on to the survey. Those who disagreed were prompted to exit the web page by closing their browser.

A total of 371 individuals were screened for the hair pulling survey; however, 31 were not offered entry into the full survey due to failure to pass the eligibility screen. Reasons for this included: lack of English fluency (n =2), age below 18 (n =4), lack of recurrent hair pulling (n =17); or failure to provide consent (n =9). This yielded 339 eligible respondents in the TTM group.

A total of 304 individuals were screened for the skin picking survey; however 19 were not offered entry into the full survey because they failed to pass the eligibility screen. Reasons included: lack of English language fluency (n =1), age below 18 (n =6), lack of recurrent skin picking (n =7); or failure to provide consent (n =5). This yielded 285 eligible respondents in the ExD group. No compensation was administered for completion of the hair pulling or skin picking surveys. IP addresses were tracked to ensure participants did not complete the survey twice.

4.2. Non-affected comparison sample survey procedure

AMT participants responded to a brief posting for a 7-question survey (paying $0.05) that assessed eligibility for a 30-min sleep quality survey (paying a $1.50 bonus). For quality control purposes, and in accordance with previous research (Crump, McDonnell, & Gureckis, 2013; Daly & Nataraajan, 2015) the posting was only visible to AMT users with a 95% approval rating who had completed at least 50 prior surveys and resided within the U.S. in order to include participants who spoke English and ensure our sample was representative of the racial and ethnic of the U.S. (Paolacci, Chandler, & Ipeirotis, 2010). AMT participants responding to the study post were directed to a Survey Monkey web link to complete the screening survey. The screening survey was completed by 848 comparison participants. Those who were female, demonstrated English fluency, were aged 18 or older denied significant mental health problems or disorders, denied current/past recurrent hair pulling and skin picking, and denied intellectual disability were presented with a Survey Monkey link directing them to a separate 30-min sleep survey. Prior to completing the 30-min survey, participants (N =390) were presented with a web-based IRB-approved study information form and asked to indicate whether or not they understood the information and agreed to participate by checking one of two boxes.

4.3. Eligibility criteria for BFRBD and non-affected comparison groups

Of interest in the present investigation were participants meeting DSM-5 diagnostic criteria for TTM and ExD, assessed via individual questions mapping onto each criterion in the style of previous BFRB internet surveys (Tucker et al., 2011; Woods et al., 2006). Therefore, of the eligible hair pulling survey respondents (N =339), only those meeting the following TTM criteria (N =259; 76.4%) were included. Of the eligible skin picking survey respondents (N =285), 182 (63.9%) met diagnostic criteria for ExD.

To ensure the comparison group best mirrored psychiatrically healthy populations, subjects endorsing 1) a lifetime diagnosis with a psychiatric disorder, 2) current use of psychotropic medications for mental health problems, 3) any hair pulling symptoms (resulting in a score above 0) on the MGH-HPS (Keuthen et al., 1995), and 4) any skin picking symptoms (resulting in a score above 0) on the SPS-R (Snorrason & Olafsson, 2012) were excluded from the final comparison sample. Also, failure to complete any items after providing consent (n =1) resulted in removal from the dataset prior to analysis. For quality control, per guidelines for AMT research (Goodman et al., 2013), any subjects who failed either of two attention check questions, including "Select the answer choice *moderately*" and "Select *very true for me* if you live in the United States" were excluded. A total of 242 participants were excluded, yielding a sample of 148.

4.4. Statistical analyses

One-way ANOVAs with Tukey's HSD correction and two-tailed tests for significance were conducted to examine potential group differences on demographic variables (age, education level, and household income) and clinical variables (BSI anxiety and depression subscales; see Table 1. Significant group differences were examined with follow-up pairwise comparisons. Chi-square was used to compare groups on gender, racial/ethnic minority status, and medication use for sleep. It was determined *a priori* that age, anxiety (BSI anxiety subscale), and depression (BSI depression subscale) would be examined as potential covariates in primary analyses (as these variables have previously been found to be associated with sleep problems), (Alvaro, Roberts, & Harris, 2013) as well as any other demographic variables for which there were significant group differences. Significant covariates were retained in final analyses and are reported in *Results*.

A one-way ANOVA was used to compare groups on PSQI Total score, and one-way MANOVA to examine PSQI subscale scores, while controlling for anxiety and depression symptoms (BSI subscales), with Tukey's HSD correction and two-tailed tests for significance. Significant group differences were examined with follow-up pairwise comparisons. Partial correlations controlling for anxiety and depression symptoms were used to assess relationships between sleep functioning and hair pulling and skin picking severity and subtype using Bonferroni correction. Independent samples t-tests were conducted to explore differences in clinical characteristics between individuals engaging in hair pulling and skin picking during sleep and those not endorsing this behavior. Because these analyses were exploratory and conducted for future hypothesis generation, and the number of participants who pulled during sleep was small, alpha was set at .05.

5. Results

5.1. Group differences in sleep functioning

There were significant group differences in use of medications for sleep; as compared to 13% of controls, 21% of the TTM and 32% of the ExD groups reported use of either prescribed or over-the-counter medications for sleep. There were also group differences on the PSQI Total score, $F(2, 486) = 9.99$, $p < 0.001$), such that the control group reported significantly fewer sleep problems ($M = 6.48$, $SD = 3.30$) than the TTM ($M = 7.85$, $SD = 3.66$) and ExD ($M = 8.16$, $SD = 3.21$) groups, with no differences between the two affected groups. These group differences in PSQI Total score remained even when controlling for the significant effects of BSI anxiety and depression t-scores, $F(2, 470) = 17.834$, $p < 0.001$).

In exploring indices of sleep problems (PSQI subscale scores), there were significant group differences for sleep quality ($p = 0.006$), sleep disturbances ($p = 0.002$), need meds to sleep ($p < 0.001$), and daytime dysfunction due to sleepiness ($p < 0.001$), even after controlling for the significant effects of age and BSI anxiety and depression t-scores. A consistent pattern of results emerged, such that the comparison group reported lower impairment scores than the TTM and ExD groups, but TTM and ExD groups did not differ from each other, on each of these PSQI subscales. See Table 1 for overall *F*-test statistics and group means.

5.2. Associations between sleep disturbance and hair pulling/skin picking severity and subtype

In order to assess relationships between sleep disturbance and hair pulling severity and subtype, bivariate correlations between MGH-HPS Total, MIST-A-R Intention and Emotion scales, PSQI Total, and PSQI subscales were performed. The MGH-HPS Total was associated with PSQI Sleep Efficiency ($r = 0.13$, $p = 0.04$, $n = 233$), and the MIST-A-R Emotion scale was positively correlated with PSQI Sleep Disturbances ($r = 0.16$, $p = 0.02$, $n = 221$). However, correlations did not survive control for internalizing symptoms (BSI anxiety and depression t-scores) and Bonferroni correction ($\alpha = 0.005$). Bivariate correlations were also performed to assess relationships between skin picking severity (SPS-R Total), subtype (MIDAS Automatic and Focused subscales), and sleep disturbances (PSQI Total and subscale scores). SPS-R Total was positively correlated with PSQI Total ($r = 0.29$, $p < 0.001$, $n = 156$), PSQI Sleep Disturbances ($r = 0.23$, $p = 0.003$, $n = 167$), and PSQI Daytime Dysfunction due to Sleepiness ($r = 0.38$, $p < 0.001$, $n = 172$). MIDAS Focused was positively correlated with PSQI Daytime Dysfunction due to Sleepiness ($r = 0.16$, $p = 0.04$, $n = 161$), and MIDAS Automatic was positively correlated with both PSQI Total ($r = 0.18$, $p = 0.03$, $n = 154$) and PSQI Sleep Latency ($r = 0.19$, $p = 0.02$, $n = 164$). However, these correlations did not survive controlling for BSI anxiety and depression t-scores and use of Bonferroni correction ($\alpha = 0.005$).

5.3. Hair pulling and skin picking in bed prior to falling asleep

Participants in the TTM group were asked “In the past month, how often have you pulled out your hair after getting into bed but before falling asleep?” Forty-nine (19.1%) participants reported “Never or not in the past month,” 35 (13.6%) reported 1–3 times in the past month, 33 (12.8%) endorsed “1 or 2 times in the past week,” 52 (20.2%) reported 3–6 times per

week, and 88 (34.2%) endorsed “daily.” Similarly, participants in the ExD group were asked “In the past month, how often have you picked your skin after getting into bed but before falling asleep?” Thirty-one (17.1%) participants reported “Never or not in the past month,” 16 (8.8%) reported 1–3 times in the past month, 40 (22.1%) endorsed “1 or 2 times in the past week,” 26 (14.4%) reported 3–6 times per week, and 68 (37.6%) endorsed “daily”. Table 3 details additional information provided by participants in TTM and ExD groups in response to the question “What makes it hard to stop pulling out your hair (picking your skin) after getting into bed but stop pulling out your hair (picking your skin) after getting into bed but before falling asleep? In both groups, the most frequent response was “I zone out and pull my hair (pick my skin) without thinking about what I am doing.”

5.4. Hair pulling during sleep

Participants in the TTM group were asked “In the past month, how often have you pulled out your hair during your sleep (meaning after you’ve fallen asleep)?” Thirty-three individuals (12.9%) reported at least some pulling during sleep in the past month. Of those 17 (6.6%) reported pulling during sleep 1–3 times in the past month, four (1.6%) reported pulling during sleep 1 or 2 times per week, seven (2.7%) reported pulling hair during sleep 3–6 times per week, and five (2.0%) reported daily pulling during sleep. Participants were also asked “On an average day within the past month, what percentage of your hair pulling has occurred during your sleep?” Of those 33 endorsing at least some pulling in the last month, only one participant reported pulling hair exclusively during sleep. One quarter (24.1%) reported that more than half of daily pulling episodes occurred during sleep. On average, 29.31% of daily pulling episodes occurred during sleep (SD =33.18). When participants were asked how they knew they had pulled during sleep, 18 (54.5%) had discovered hair strands when they woke up, 18 (54.5%) had woken up during a pulling episode, six (18.2%) had woken up with pain in pulling areas (e.g., scalp), five (15.2%) had been informed of their pulling during sleep by someone else, and five (15.2%) gave other reasons (several participants endorsed more than one reason).

In order to explore clinical correlates of hair pulling during sleep, we compared the participants who reported at least some hair pulling during sleep (n =33) with participants who reported no hair pulling during sleep (n =224) on demographic, pulling/picking, internalizing symptoms, and sleep disturbance. Clinical differences between those endorsing hair pulling during sleep and those not endorsing hair pulling during sleep were not significant after applying Bonferroni correction (α=0.003; see Table 4).

5.5. Skin picking during sleep

Forty-nine individuals (26.9%) in the ExD group reported picking skin during sleep. Thereof, 20 (11.2%) reported doing so 1–3 times per month, 9 (5.1%) reported a frequency of 1 or 2 times per week, 10 (5.6%) reported doing this 3–6 times per week, and 10 (5.6%) endorsed daily occurrence. No participant reported picking skin exclusively during sleep. Only two participants (4.1%) reported that more than half of their picking episodes occurred during sleep. On average, 18.19% of picking episodes were reported to occur during sleep (SD =19.86). When participants were asked how they knew they had engaged in skin picking during sleep, 35 (71.4%) had noticed skin residue/blood under fingernails upon

wakening, 23 (46.9%) had woken up with fresh sores, 22 (44.9%) had woken up during a picking episode, and seven (14.3%) had been told by someone else that they had engaged in this behavior (several participants endorsed more than one reason).

Table 4 shows a comparison between participants who reported at least some skin picking during sleep (n =49) and those who reported no skin picking during sleep (n =133). Bonferroni correction of α=0.003 was applied. Those who reported skin picking during sleep endorsed significantly greater skin picking severity (t=−3.63, p=0.001), anxiety (t=−3.32, p=0.001) and depression (t=−3.90, p <0.001) compared to those who denied picking during sleep. Additionally, participants who reported picking skin during sleep endorsed greater overall sleep problems (t=−4.95, p <0.001), poorer sleep quality (t=−3.91, p <0.001), longer sleep latency (t=−3.42, p=0.001), and greater sleep disturbance (t=−3.67, p <0.001) on the PSQI.

6. Discussion

The present study is the first to compare sleep disturbance in individuals with TTM, ExD, and non-affected controls. Results showed that individuals with BFRBDs (i.e., TTM and ExD) endorsed greater sleep disturbance relative to unaffected participants, even after controlling for significant effects of anxiety and depression symptoms. The pattern of findings was highly similar between TTM and ExD samples. It is possible that this is due to the presence of ExD and TTM comorbidity in these groups, which was not assessed. Alternatively, it may signify that these disorders are similar with regard to sleep characteristics, as they are with respect to other clinical features (Snorrason, Belleau et al., 2012). Our findings also indicated a positive relationship between sleep disturbance and TTM and ExD severity and subtype, although the relationship was not significant after controlling for significant effects of anxiety and depression symptoms. Overall, these findings suggest an association between sleep disturbance and BFRBD symptoms that may be partly accounted for by internalizing symptoms.

Nevertheless, the nature of this relationship remains unclear. For example, for some individuals it is possible that BFRBD symptoms directly interfere with sleep. Pulling and picking episodes are often difficult to control and can last for hours, with symptoms often worsening in the evening (Christenson, 1991a); Wilhelm, Keuthen, & Deckersbach, 1999). It is not uncommon for individuals who pull or pick in the evening to complain of significantly shortened sleep duration as a result of prolonged pulling or picking during this time period (Christenson & Mansueto, 1999). It is also possible that insufficient sleep contributes to the development or maintenance of BFRBD symptoms in vulnerable individuals (e.g., through mechanisms of inhibitory control or regulation of internalizing symptoms; Coles, Schubert, & Nota, 2015; Drummond, Paulus, & Tapert, 2006). An alternative explanation is that internalizing symptoms emerge as a function of pulling or picking, contributing to sleep disturbance. Additionally, studies examining diurnal variation in affect indicate depressive and anxiety symptoms often worsen in the evening (Rusting & Larsen, 1998); Wirz-Justice, 2008). It may be the case that BFRBDs, sleep, and internalizing symptoms are complexly interrelated. Furthermore, it is possible that BFRBDs and sleep disturbance are not directly related but reflect a shared underlying vulnerability (e.g., through the serotonergic and

dopaminergic systems both implicated in TTM and sleep disturbance; Harvey, Murray, Chandler, & Soehner, 2011; Woods & Houghton, 2014). Given the cross sectional design of our study, we are unable to determine if there is any causal relationship between sleep and BFRBDs. Future experimental and longitudinal evidence are needed to examine the relationship between BFRBDs, sleep disturbance, and underlying mechanisms.

An exploratory aim of the study was to examine the rates and clinical correlates of hair pulling and skin picking occurring in bed at night before falling asleep. Similarly high rates of participants with TTM and ExD (80% and 82%, respectively) endorsed engagement in hair pulling and skin picking before sleep. With respect to affective cues associated with symptom expression, a lack of awareness was endorsed most highly, followed by worrying, boredom, or the perceived relaxing and sleep-inducing properties of pulling and picking. These findings highlight time in bed before sleep as a high-risk setting in which pulling and picking may commonly occur, and draw attention to several cues (i.e., low awareness, anxiety, boredom, relaxation) which may contribute to symptom exacerbation in this context. Clinicians should specifically ask about such night-time patterns in assessment and treatment of affected individuals.

The final goal of the study was to ascertain the prevalence and clinical correlates of pulling and picking during sleep. In the TTM sample, 13% reported pulling during sleep at least once during the past month, and 27% of the ExD sample reported picking skin during sleep at least once during the past month. However, only one participant reported hair pulling occurring solely during sleep, and none reported picking occurring solely during sleep, suggesting that sleep-isolated hair pulling and picking may be relatively uncommon. Future research is needed to clarify whether sleep-isolated BFRBs constitute a separate phenomenon or whether degree of engagement in BFRBs during sleep and associated characteristics runs on a continuum.

With respect to demographic and clinical correlates of sleep-related BFRBDs, the findings showed no significant differences between those who endorsed hair pulling during sleep and those who did not In the ExD sample, those subjects reporting skin picking during sleep exhibited greater picking severity, increased anxiety and depression, and increased sleep problems (i.e., poorer sleep quality, longer sleep latency, and greater sleep disturbance,). The robustness of findings among the ExD sample may indicate that skin picking during sleep is more problematic than hair pulling during sleep with respect to the tested variables. However, we do not know which factors contribute most to the development and maintenance of this behavior. It is possible that higher skin picking severity in those who pick during sleep may increase the habitual nature of the behavior such that it carries through to the sleep process. Additionally, there may be pre-existing sleep problems that leave individuals' susceptible to picking during sleep. Also, as previously mentioned there may be comorbid symptoms that contribute to this behavior. Furthermore, for some individuals, picking in this context may be associated with increased nocturnal itching, thought to be related to circadian patterns of body temperature regulation (Sack & Hanifin, 2010).

As mentioned above, this research has clinical implications for both assessment and intervention (e.g., stimulus control procedures/function-based assessment, symptoms monitoring) for hair pulling and skin picking. Specifically, findings highlight the need for assessment of sleep-related factors contributing to hair pulling and skin picking symptom exacerbation. As our current assessment tools for BFRBs do not include items regarding sleep, clinicians should explicitly inquire about sleep-related patterns of pulling or picking during assessment and intervention. Specifically, during stimulus control/ function-based assessment, clinicians should assess whether being on or in bed before falling sleep is a high-risk setting for pulling or picking, and any associated affective cues (e.g., anxiety, boredom). Any identified triggers should be addressed with suggested environmental modifications or behavioral interventions (i.e., calming bed time routine, going to bed only when ready to sleep, cognitive behavioral therapy to address anxiety, etc.). Additionally, although less common, clinicians should assess whether patients are aware of any engagement in BFRBs during sleep. If so, suggested interventions may include wearing protective clothing items to bed (i.e., gloves, hat, long sleeves, etc.); or, in more severe cases, undergoing polysomnography to assess underlying dysregulation in sleep maintenance processes, or receiving medication or behavioral interventions to address sleep disturbance or anxiety.

Findings should be considered within the context of study limitations. Specifically, although the study-specific sleep questions were developed through a review of patient concerns and the extant literature, and a collaborative editing process, these items were not validated. Additionally, our findings must be interpreted at the mean age, anxiety, and depression level for the samples collected. Also, due to the internet survey methodology utilized, TTM and ExD diagnoses could not be confirmed by a clinician; and the degree to which mental health and health problems were fully absent from our comparison group could not be established. However, great efforts were made to exclude those in the hair pulling and skin picking samples not meeting DSM-5 diagnostic criteria for TTM and ExD, and those in the comparison group endorsing psychotropic medication use and/or mental health problems from analysis. Additionally, the clinical characteristics of our TTM and ExD samples, as seen in Table 2, are representative of those previously found in the literature (Snorrason, Belleau et al., 2012). Nevertheless, an additional limitation is that we do lack information regarding BFRBD diagnostic comorbidity. Although we do know that 37.1% of those in the TTM group endorsed “skin picking resulting in tissue damage” and 12.4% of those in the SPD group endorsed “hair pulling resulting in hair loss or thinning” (see Table 2), respondents to the hair pulling survey were not asked full ExD diagnostic criteria and respondents to the skin picking survey were not asked full TTM diagnostic criteria. Therefore, we do not know the extent to which TTM-ExD comorbidity may have influenced findings. Furthermore, because the surveys were devoted to the study of sleep and advertised as such, a selection bias may have occurred, whereby individuals with sleep problems may have been more likely to partake in the study relative to those without such difficulties. However, the survey was advertised as pertaining to sleep quality in the comparison group also. Additionally, the BFRBD and comparison group surveys were conducted under different contexts, with monetary gain potentially increasing comparison group motivation to partake in the study. Finally, as this study featured self-report measures, we lack clarity

regarding the potential presence of objective sleep disturbance and sleep-related pulling and picking.

Future studies should utilize both clinician-rated interviews, and objective measures, including actigraphy or polysomnography to corroborate the present subjective sleep disturbance findings found in TTM and ExD. Nonetheless, this (to our knowledge) is the first study to compare sleep in individuals with TTM and ExD, to a non-affected sample of adults, and provides preliminary evidence the potential role of sleep in BFRBDs.

Acknowledgments

This work was supported by the National Institute of Mental Health of the National Institutes of Health Institutional T32 Training Grant under Award Number MH073517–10. The content is the responsibility of the authors and is not necessarily representative of the views of the National Institutes of Health.

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J Obsessive Compuls Relat Disord. Author manuscript; available in PMC 2020 May 28.

Table 1

Demographic and clinical characteristics of sample by group.

	TTM	ExD	Comparison	Statistical Test	*p*-	Effect Size
	(*n* =259)	(*n* =182)	(*n* =148)	(X^2/*F*)	value	(η^2/*V*)
Demographics						
% Female	96.5%	95.6%	99.3%	4.09	0.13	0.08
% Racial/Ethnic Minority	13.5%[b]	7.1%[a,c]	16.9%[b]	7.70	**0.022**	0.11
Age M(SD)	31.69 (12.22) [b,c]	36.23 (13.51)[a]	38.61 (12.29)[a]	15.67	< **0.001**	0.051
Household Income M(SD)	3.23 (1.78)	3.19 (1.64)	2.80 (1.54)	1.08	0.34	0.004
% Medications for sleep	21%[c]	32%	13%[a]	9.08	< **0.001**	0.031
Brief Symptom Inventory Subscale T-scores M(SD)						
Anxiety	41.35 (9.72)	41.47 (9.69)	42.66 (10.54)	0.85	0.43	0.003
Depression	47.68 (11.66)[c]	47.95 (10.64)[c]	44.08 (11.21)[a,b]	5.29	**0.005**	0.020
Pittsburgh Sleep Quality Index M(SD)						
PSQI Total	7.85 (3.66)[c]	8.16 (3.21)[c]	6.48 (3.30)[a,b]	9.99	< **0.001**	0.039
Overall Sleep Quality	1.33 (0.70)[c]	1.38 (0.73)[c]	1.21 (0.71)[a,b]	2.52	0.08	0.009
Sleep Latency	1.53 (1.10)	1.50 (0.97)	1.32 (0.96)	2.04	0.13	0.007
Sleep Duration	0.67 (0.99)	0.72 (0.97)	0.77 (1.01)	0.46	0.63	0.002
Sleep Efficiency	0.73 (1.02)	0.66 (0.87)	0.55 (0.92)	1.46	0.23	0.005
Sleep Disturbances	1.36 (0.58)[c]	1.37 (0.57)[c]	1.24 (0.48)[a,b]	2.37	0.10	0.009
Needs Meds to Sleep	0.70 (1.11) [c]	0.87 (1.24) [c]	0.38 (0.88)[a,b]	7.94	< **0.001**	0.028
Daytime Dysfunction due to Sleepiness	1.51 (0.83) [c]	1.65 (0.78) [c]	1.01 (0.70) [a,b]	28.28	< **0.001**	0.094

Note. TTM = Trichotillomania; ExD = Excoriation Disorder; PSQI = Pittsburgh Sleep Quality Index.

Household income was rated on a scale of 1 through 6 where 1=$20,000 or less, 2=$20,001 - $40,000, 3=$40,001 - $60,000, 4=$60,001=$80,000, 5=$80,001 - $100,000, 6=$100,000. Boldedindicates group differences significant at $p < 0.05$;

[a]Significantly different from TTM

[b]Significantly different from ExD

[c]Significantly different from controls.

Table 2

Clinical characteristics of TTM and ExD.

	TTM (*n* =259)		ExD (*n* =182)
MGH-HPS M(SD)	15.76 (3.77)	SPS-R Total M(SD)	16.54 (4.77)
		SPS-R Severity	9.48 (2.57)
		SPS-R Impairment	7.06 (2.86)
MIST-A Focused M(SD)	42.74 (15.08)	MIDAS Focused M(SD)	20.72 (4.68)
MIST-A Automatic M(SD)	27.06 (9.06)	MIDAS Automatic M(SD)	18.05 (4.71)
Age of Onset M(SD)	12.54 (6.94)	Age of Onset M(SD)	15.97 (12.41)
Duration of Illness M(SD)	19.10 (12.73)	Duration of Illness M(SD)	20.02 (13.73)
Most Common Pulling sites N(%)		Most Common Picking Sites N(%)	
Scalp	173 (66.8%)	Face	56 (31.5%)
Eyelashes	37 (14.3%)	Hands	25 (14.0%)
Eyebrows	24 (9.3%)	Scalp	23 (12.9%)
Pubic region	8 (3.1%)	Arms	22 (12.4%)
Comorbid BFRBs[a] N(%)		Comorbid BFRBs[a] N(%)	
Skin Picking	95 (37.1%)	Hair Pulling	22 (12.4%)
Nose Picking	18 (7.0%)	Nose Picking	36 (20.3%)
Nail Biting	49 (19.1%)	Nail Biting	41 (23.2%)
Cheek/Lip Biting	47 (18.4%)	Cheek/Lip Biting	40 (22.6%)
Lifetime Psychiatric Diagnosis N(%)		Lifetime Psychiatric Diagnosis N(%)	
Generalized Anxiety Disorder	105 (40.5%)	Generalized Anxiety Disorder	87 (47.8%)
Social Phobia	11 (4.2%)	Social Phobia	26 (8.8%)
Specific Phobia	5 (1.9%)	Specific Phobia	2 (1.1%)
Panic Disorder	25 (9.7%)	Panic Disorder	16 (8.8%)
Agoraphobia	3 (1.2%)	Agoraphobia	2 (1.1%)
Major Depressive Disorder	78 (30.1%)	Major Depressive Disorder	77 (42.3%)
Bipolar Disorder	18 (6.9%)	Bipolar Disorder	8 (4.4%)
Obsessive Compulsive Disorder	53 (20.5%)	Obsessive Compulsive Disorder	35 (19.2%)
Body Dysmorphic Disorder	5 (1.9%)	Body Dysmorphic Disorder	10 (5.5%)
Skin Picking Disorder	22 (8.5%)	Hair Pulling Disorder	14 (7.7%)
Posttraumatic Stress Disorder	24 (9.3%)	Posttraumatic Stress Disorder	24 (13.2%)
Attention Deficit Hyperactivity Disorder	27 (10.4%)	Attention Deficit Hyperactivity Disorder	26 (14.3%)
Anorexia Nervosa	9 (3.5%)	Anorexia Nervosa	8 (4.4%)
Bulimia Nervosa	10 (3.9%)	Bulimia Nervosa	9 (4.9%)
Alcohol Abuse/Dependence	10 (3.9%)	Alcohol Abuse/Dependence	4 (2.2%)
Drug Abuse/Dependence	5 (1.9%)	Drug Abuse/Dependence	7 (3.8%)
Tourette's Disorder	1 (0.4%)	Tourette's Disorder	0 (0.0%)
Schizophrenia	0 (0.0%)	Schizophrenia	1 (0.5%)

[a] *Note.* Question referred to engagement in BFRBs (body-focused repetitive behaviors) resulting in physical damage; b. question referred to lifetime psychiatric diagnosis by a health professional.

MGH-HPS = Massachusetts General Hospital Hairpulling Scale; SPS-R = Skin Picking Scale-Revised; MIST-A = Milwaukee Inventory for Subtypes of Trichotillomania-Adult; MIDAS = Milwaukee Inventory for Dimensions of Adult Skin Picking.

Table 3

Summary of affective cues associated with hair pulling or skin picking while in bed before falling asleep at night.

"What makes it hard to stop pulling out your hair (picking your skin) after getting into bed but before falling asleep?"*	**TTM *n* =208[a]**	**ExD *n* =150[a]**
	N (%)	**N (%)**
Pulling out my hair (picking my skin) at night relaxes me and helps me fall asleep	68 (32.7)	30 (20)
I pull my hair (pick my skin) at night when I'm bored while waiting to fall asleep	84 (40.4)	57 (38)
I pull my hair (pick my skin) while worrying about things before falling asleep	127 (61.1)	92 (61.3)
I zone out and pull my hair (pick my skin) without thinking about what I am doing	161 (77.4)	120 (80)
Other	24 (11.5)	29 (19.3)

**Note.* This represents two independent questions designated for hair pulling and skin picking survey samples.

[a]Total N represents participants with TTM or ExD endorsing pulling or picking while in bed but before falling asleep 1–3 times or greater in the past month.

Table 4

Comparison of individuals with TTM or ExD with and without hair pulling or skin picking during sleep.

	Hair pulling during sleep (*n* =33)	No hair pulling during sleep (*n* =226)	*t*/χ^2	Sig.	*d*/*V*	Skin picking during sleep (*n* =49)	No skin picking during sleep (*n* =133)	*t*/χ^2	*p*-value	*d*/*V*
Demographics										
Female N(%)	32 (97.0)	215 (96.4)	0.000	1.000	–	47 (95.9)	124 (96.1)	0.000	1.000	–
Racial/Ethnic Minority N(%)	9 (27.3)	27 (12.1)	4.288	0.038	0.016	4 (8.20)	10 (7.80)	0.000	1.000	–
Age M(SD)	29.97 (10.41)	31.89 (12.29)	0.852	0.395	0.169	36.39 (12.32)	36.42 (14.06)	0.015	0.988	0.002
Hair Pulling/Skin Picking										
Age of Onset M(SD)	10.24 (6.34)	12.85 (6.98)	2.021	0.044	0.391	16.96 (14.60)	15.43 (11.45)	−0.643	0.522	0.117
Problem Duration M(SD)	19.73 (11.68)	18.91 (12.85)	−0.345	0.731	0.067	19.21 (11.83)	20.65 (14.42)	0.609	0.543	0.109
MGH-HPS/SPS-R Total M(SD)	17.03 (3.04)	15.57 (3.84)	−2.060	0.040	0.422	18.83 (5.30)	15.73 (4.31)	−3.634	**0.001**	0.643
MIST-A Automatic/Intention	25.50 (9.43)	26.80 (9.16)	1.473	0.367	0.015	18.91 (4.13)	17.74 (4.89)	−1.397	0.164	0.257
MIDAS Automatic M(SD)										
MIST-A Focused/Emotion	24.39 (9.64)	24.25 (9.59)	−0.075	0.940	0.255	21.60 (4.60)	20.38 (4.68)	−1.435	0.153	0.263
Picking in Bed Before Sleep N(%)	31 (93.9%)	176 (79.3)	3.138	0.076	0.004	47 (95.9)	100 (77.5)	7.128	0.008	0.006
Brief Symptom Inventory Subscale										
T-scores M(SD)										
BSI Depression M(SD)	45.93 (12.30)	44.50 (11.62)	−0.613	0.540	0.116	48.74 (11.97)	42.29 (10.48)	−3.316	**0.001**	0.574
BSI Anxiety M(SD)	43.28 (10.23)	41.09 (9.66)	−1.130	0.260	0.218	46.09 (11.23)	39.65 (8.43)	−3.899	< **0.001**	0.649
Pittsburgh Sleep Quality Index M(SD)										
PSQI Total	9.75 (3.43)	7.58 (3.63)	−2.760	0.006	0.614	10.05 (3.15)	7.39 (2.87)	−4.948	< **0.001**	0.883
Overall Quality	1.48 (0.67)	1.31 (0.71)	−1.308	0.198	0.241	1.72 (0.78)	1.24 (0.67)	−3.910	< **0.001**	0.652
Latency	1.97 (1.07)	1.47 (1.09)	−2.355	0.019	0.454	1.89 (0.93)	1.33 (0.93)	−3.421	**0.001**	0.597
Duration	0.83 (1.10)	0.65 (0.98)	−0.885	0.377	0.170	0.76 (1.02)	0.69 (0.92)	−0.425	0.671	0.072
Efficiency	1.13 (1.15)	0.66 (0.99)	−2.410	0.017	0.435	1.02 (1.04)	0.52 (0.75)	−2.964	0.004	0.548
Disturbances	1.57 (0.57)	1.33 (0.58)	−2.076	0.039	0.426	1.62 (0.58)	1.27 (0.55)	−3.671	< **0.001**	0.634
Medication Need	1.10 (1.30)	0.64 (1.06)	−1.868	0.070	0.382	1.07 (1.40)	0.78 (1.17)	−1.219	0.227	0.219
Day Dysfunction	1.65 (0.95)	1.49 (0.82)	−0.988	0.324	0.172	1.91 (0.78)	1.55 (0.77)	−2.733	0.007	0.470

Note. Sig. = Significance (2-tailed); Bolded sig. = significant at corrected alpha of 0.003 based on 19 comparisons in each group; MGH-HPS = Massachusetts General Hospital Hairpulling Scale; SPS-*R* = Skin Picking Scale-Revised; MIST-A = Milwaukee Inventory for Subtypes of Trichotillomania-Adult; MIDAS = Milwaukee Inventory for Dimensions of Adult Skin Picking; BSI = Brief Symptom Inventory; PSQI = Pittsburgh Sleep Quality Inventory.