

# Daytime rumination as a feature of Insomnia Disorder: sleep related cognition is not merely a problem of the night

L. PALAGINI<sup>1</sup>, M. MAURI<sup>1</sup>, T. BANFI<sup>2</sup>, I. MAZZEI<sup>1</sup>, A. GRONCHI<sup>1</sup>, E. BONANNI<sup>3</sup>,  
M. MAESTRI<sup>3</sup>, D. RIEMANN<sup>4</sup>, C.E. CARNEY<sup>5</sup>, L. DELL'OSSO<sup>6</sup>

<sup>1</sup> Department of Clinical Experimental Medicine, Psychiatric Unit II, University of Pisa, Italy;

<sup>2</sup> Department of Translational Research and of New Surgical and Medical Technologies, Università di Pisa, Pisa, Italy; <sup>3</sup> Department of Clinical Experimental Medicine, Neurologic Unit, University of Pisa, Italy; <sup>4</sup> Department of Clinical Psychology and Psychophysiology / Sleep Medicine, Center for Mental Disorders, University of Freiburg Medical Center, Freiburg, Germany; <sup>5</sup> Department of Psychology, Ryerson University, Toronto, ON, Canada; <sup>6</sup> Department of Clinical Experimental Medicine, Psychiatric Unit I, University of Pisa, Italy

## ABSTRACT

Night-time sleep related cognitions have been shown to play a perpetuating role in insomnia. According to the cognitive model of insomnia day time cognitions (i.e. worry, rumination, etc.) may also contribute to it. The aim of this study was to investigate the possible role of daytime sleep-related rumination in Insomnia Disorder (n= 55, mean age 49.7±16.7 years), Obstructive Sleep Apnea Syndrome (OSAS) (n=33, mean age 58.1±10.2 years) and healthy subjects (n=33, mean age 49.8±13.9), using a set of sleep related variables which included the Daytime Insomnia Symptom Response Scale (DISRS), the Dysfunctional Beliefs about Sleep Scale (DBAS), the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). Daytime sleep related rumination was higher in insomnia when compared to both OSAS (p<.001) and good sleepers (p<.001). In insomnia, elevated sleep related daytime rumination was best determined by unhelpful sleep related beliefs (coeff=0.3 p=.004), while in OSAS by insomnia symptoms (coeff=0.9, p=.02). These findings suggest that the association between insomnia-specific daytime rumination and unhelpful beliefs may be considered a cognitive feature of insomnia. In insomnia, sleep related cognition may dominate the 24-hour period. This finding might be of use for further investigations studying therapeutic strategies acting on cognitive processes to prevent and treat insomnia disorder and its comorbid conditions.

## Key words

Chronic insomnia • Daytime rumination • Unhelpful sleep related beliefs • Cognitive behavioral therapy

## Introduction

Chronic insomnia is a highly prevalent health problem afflicting almost one-third of the adult population (Roth et al., 2003; APA, 2013; AASM, 2014). It is frequently related to different co-morbid conditions which include psychiatric and neurodegenerative disorders, neuroendocrine, and cardiovascular diseases (Baglioni et al., 2011; Knutson, 2012; Riemann et al., 2012; Palagini et al., 2013; Fernandez-Mendoza et al., 2013; Riemann,

et al. 2015). Moreover, insomnia is involved in the development of cognitive impairment (Yaffe, 2014), it is an independent risk factor for work disability and reduced work performance (Kucharczyk, 2012) and it is associated with high direct and indirect costs for the healthcare system and society (Léger, 2010). Cognitive behavioral therapy for insomnia is considered the first line treatment for insomnia disorder (Schutte-Rodin, et al., 2008): understanding the mechanisms involved in the development and maintenance of insomnia and

its related cognition may thus be useful for insomnia prevention and treatment.

Recent research described that patients suffering from insomnia report increased 24 hours cognitive and physiological hyperactivity according to the “hyperarousal model of insomnia” (Bonnet et al., 2010; Riemann et al., 2010; APA, 2013; AASM 2014; Riemann et al., 2015). Research has supported a role for cognitive processes in the development and maintenance of insomnia. Previous studies have consistently shown that subjects with insomnia have more *unhelpful* sleep related thoughts than good sleepers (Morin, 1993; Harvey, 2002; Morin and Espie, 2003; Carney and Edinger, 2006; Harvey et al., 2014). This mental activity has been described to focus on unhelpful beliefs and attitudes about sleep and worries about sleep (Harvey 2002, Carney, and Edinger, 2006; Carney et al., 2006; Carney et al. 2010; Morin et al., 2007) which may interfere with sleep, thus contributing to the perpetuation of insomnia (Harvey, 2002; Morin, 2003, Morin et al., 2007, Carney et al., 2010). It has been hypothesized, according to the cognitive model of insomnia that subjects with insomnia suffer from this type of repetitive thinking throughout the 24-hour period (Harvey, 2002, Harvey et al., 2014).

While certain repetitive thought processes, such as worry, have been more widely explored within the context of insomnia (Harvey, 2002; Harvey et al., 2014), rumination has not received the same degree of attention with respect to its role for insomnia. Rumination and worry have been used for a long time as interchangeable terms, but the content of these two repetitive thought processes has been shown to be different (Carney and Edinger, 2006; Carney et al., 2006; Carney et al., 2010; Carney et al., 2010; Carney et al., 2013)

Rumination refers to a repetitive thought process, which is focused on past failure or the cause of current distress and it has been typically described within the context of Major Depressive Disorder (Watkins 2004; Watkins et al., 2005). Although, in the recent past, an increased interest has been developed on rumination in the context of insomnia (Carney and Edinger, 2006; Carney, et al, 2006; Carney et al., 2010; Carney et al., 2010; Carney et al., 2013), little is known about the association between daytime sleep related rumination and other cognitive aspects in insomnia.

Thus, the primary objective of this study was to evaluate daytime sleep related rumination in

Insomnia Disorders (ID), in healthy controls (H) and, as a novel aspect, in subjects with another sleep disorder such as Obstructive Sleep Apnea Syndrome (OSAS) with no insomnia disorder. It was hypothesized that insomnia subjects will have more sleep related rumination than OSAS or healthy subjects. The second aim was to explore the possible associations between daytime sleep related rumination and other cognitive aspects that may contribute to the development and maintenance of insomnia such as *unhelpful* beliefs and attitude about sleep in subjects with ID and in subjects with OSAS. This aspect has never been assessed before. It was hypothesized that sleep related rumination would be related to other cognitive processes such as *unhelpful* beliefs and attitudes about sleep in subjects with insomnia. To address these aims we evaluated insomnia severity and sleep quality, while controlling for psychiatric symptoms such as anxiety and depressive symptoms. The internal consistency and discriminant validity of the Italian version of the Daytime Insomnia Symptom Response Scale (DISRS), a specific tool that has been developed to evaluate daytime sleep related rumination (Carney et al., 2013) was also studied.

## Methods

### *Subjects selection and psychometric questionnaire administration*

From January 2014 to January 2015, consecutive outpatients attending the Sleep Center of the Psychiatry Unit II, University of Pisa, Italy, who met diagnostic criteria for ID according to the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) (APA, 2013) and subjects meeting diagnostic criteria for OSAS according to the International Classification of Sleep Disorders, third edition – (ICSD-3) (AASM, 2014) were included in the study. In addition, participants from the general population living in the same areas the patients came from, were included in the study as healthy controls.

All the subjects underwent a face-to-face evaluation conducted by a medical doctor with an expertise in the sleep field (LP). Sleep disorders were assessed by clinical evaluation and the use of sleep questionnaires. Inclusion criteria for subjects with ID were: i) difficulty in initiating and/or maintaining sleep and/or early morning awakening, ii) the sleep disturbance

causes clinically significant distress or impairment in important areas of functioning, iii) for at least 3 months, iv) without medical/psychiatric condition, substance abuse, and/or other sleep disorder (American Psychiatric Association, 2013). Only individuals who reported sleep difficulties for at least three nights per week were enrolled in the study (APA, 2013).

Exclusion criteria for subjects with ID were: cognitive impairment, previous or present diagnosis of psychiatric disorders, other sleep disorders (i.e., obstructive sleep apnea syndrome, restless legs syndrome, etc.). In particular, subjects with a score of 1 or more on item 10 of the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) regarding self-reported symptoms or symptoms reported by the patient's roommate that were compatible with other sleep disorders were excluded according to the guidelines of the International Classification of Sleep Disorders, third edition (APA 2013).

The diagnosis of OSAS was based on clinical anamnesis and full night polysomnography (PSG). Subjects were consecutively recruited at the Sleep Disorder Center Sleep Center of the Neurologic Unit, University of Pisa, Italy. Inclusion criteria for subjects with Obstructive Sleep Apnea Syndrome, according to ICSD-3 (AASM, 2014) were: 1) Evidence of at least five obstructive apneas or hypopneas per hour of sleep at PSG and either of the following sleep symptoms: i) Nocturnal breathing disturbances: snoring, snorting/gasping, or breathing pauses during sleep. ii) Daytime sleepiness, fatigue, or unrefreshing sleep despite sufficient opportunities to sleep that is not better explained by another mental disorder (including a sleep disorder) and is not attributable to another medical condition 2) Evidence of 15 or more obstructive apneas and/or hypopneas *per* hour of sleep at PSG regardless of accompanying symptoms (AASM, 2014). Mild for Apnea hypopnea index is defined less than 15, Moderate for Apnea hypopnea Index less than 15-30 and Severe for Apnea hypopnea index is considered greater than 30 (AASM, 2014).

Exclusion criteria for subjects with OSAS were: cognitive impairment, previous or present diagnosis of psychiatric disorders, ID or other sleep disorder (i.e., narcolepsy, restless legs syndrome, etc.). In particular, OSAS subjects with a score 15 or more on total score of the Insomnia Severity index scale (ISI) (Morin, 1993), indicative of a clinically significant insomnia, were excluded from the study.

Healthy individuals were recruited from the hospital and the university personnel. Subjects underwent a face to face evaluation and the administration of questionnaires. Inclusion criteria of the healthy subjects were less than 30 min of wake time at sleep onset or wake time after sleep onset in usual nocturnal sleep (Lichstein et al., 2003). The exclusion criteria were the following: i) previously or currently diagnosed as having cognitive impairment, sleep disorders or psychiatric diseases ii) habitual use of hypnotics or bedtime alcohol, iii) engaged in shift work, and iv) failed to complete the questionnaires. The study conformed to the Declaration of Helsinki. All subjects provided written informed consent prior to entering the study.

### *Sleep Scales*

Insomnia symptom severity was evaluated with the Insomnia Severity Index (Morin, 1993). The ISI is a seven-question questionnaire for self-assessment of insomnia in the previous two weeks. It is a reliable and valid instrument to detect cases of insomnia and to estimate insomnia severity. The sum yields a global score ranging from 0 to 28. For the purposes of this study, according to the ISI authors' recommendations, the presence of insomnia symptoms was defined by an ISI score of 8 or higher (absence of insomnia symptoms sum score 0-7). A score higher than 15 was considered indicative of clinical insomnia (Morin, 1993). The ISI has been validated in Italian samples (MAPI, 2008).

Sleep quality was evaluated through the administration of the Pittsburgh Sleep Quality Index (Buysse, et al., 1989). The PSQI is a widely used, self-rated standardized questionnaire, assessing sleep quality in the previous month. The 19 questions are grouped into seven component scores whose sum yields a global PSQI score ranging from 0 to 21. Poor sleep quality was defined according to the PSQI authors' recommendations, when the PSQI sum score was higher than 5 (Buysse, et al., 1989). The PSQI has been validated in Italian samples (Curcio et al., 2013) Daytime sleep related rumination were evaluated with the Daytime Insomnia Symptom Response Scale (Carney et al., 2013). The DISRS is a self-administered 20-item questionnaire in which people are asked how frequently they engage in the behaviors listed when feeling tired (for examples: "Think about how hard it is to concentrate"; "Think about how

everything requires more effort than usual, “Think, “I won’t be able to do work because I feel so bad”, “Think about your feelings of fatigue”), on a 4-point scale ranging from 1 (*Almost Never*) to 4 (*Almost Always*). The scale is scored by adding the items and total scores range from 20 to 80, with higher scores indicating higher levels of rumination. The original version of the DISRS was translated into Italian from an independent translator and then back-translated into English. Subsequently, the consistency of the back-translated version was confirmed by the authors of the original English version.

The Dysfunctional Beliefs and Attitudes About Sleep Scale (DBAS-16) was used to evaluate unhelpful cognitions about sleep (Morin et al., 2007). The DBAS-16 consists of 16 statements exploring various sleep/insomnia-related cognitions (e.g., beliefs, attitudes, expectations, appraisals, attributions). The nature of these beliefs clustered around 5 conceptually derived themes: (a) misconceptions about the causes of insomnia (e.g., “I believe insomnia is essentially the result of a chemical imbalance”); (b) misattribution or amplification of its consequences (e.g., “I am concerned that chronic insomnia may have serious consequences on my physical health”); (c) unrealistic sleep expectations (e.g., “I must get 8 hours of sleep to feel refreshed and function well the next day”); (d) diminished perception of control and predictability of sleep (e.g., “When I sleep poorly on one night, I know it will disturb my sleep schedule for the whole week”); and (e) faulty beliefs about sleep-promoting practices (e.g., “When I have trouble sleeping, I should stay in bed and try harder”). The participant indicates his or her level of agreement to each statement on a visual analogue scale, scoring between 1 (‘strongly disagrees’) and 10 (‘strongly agree’). Items are summed up to yield a total score (maximum possible score of 160). High scores on the DBAS-16 are indicative of pronounced unhelpful beliefs about sleep (Morin et al., 2007). The DBAS has been validated in Italian samples (Devoto and Violani, 2009).

### *Psychiatric Scales*

Depressive symptoms were assessed using the Beck Depression Inventory (BDI): the BDI is a 21-question inventory for self-assessment, one of the most widely used instruments for measuring the severity of depression. The total score ranges from 0-63. According to the BDI authors’ recommendations, a

BDI score higher than 10 is indicative of depressive symptoms, while clinically significant depression is defined with BDI higher than 20. (Beck, et al., 1961, Beck, 1978).

Anxiety symptoms were assessed with the Self-rating Anxiety Scale (SAS): SAS is a 20-item self-report assessment scale based on scoring in four groups of manifestations: cognitive, autonomic, motor and central nervous system symptoms. Each question is scored on a Likert-type scale of 1-4. The total score ranges from 0-80. The presence of clinically relevant anxiety symptoms is defined by SAS scores higher than 44. (Zung, 1971; Conti, 1999).

### *Statistical analysis*

Statistical analysis was performed using NCSS statistical software 2008. Results were expressed as mean  $\pm$  standard deviation (SD). As a first step, subjects with ID, with OSAS and H subjects were evaluated for gender and age differences. Gender differences were assessed using the  $\chi^2$ -test, whereas age differences were assessed using one-way analysis of variance (ANOVA) with group as a between-factor. Cronbach alpha coefficients were calculated to test the internal consistency of the Italian version of DISRS (good internal consistency ( $0.7 \geq \alpha < 0.9$ ) (Cronbach, 1951). For discriminant validity differences in means between subjects with ID with OSAS and H controls were analyzed using ANOVA with group as a between-factor. A multiple regression model was built in order to elucidate independent determinants of DISRS in subjects with insomnia and with OSAS.

## **Results**

### *Descriptive statistics*

Demographic and clinical characteristics of the samples are shown in Table 1. Results are expressed as mean  $\pm$  Standard Deviation (SD).

Among the 55 subjects enrolled with ID, those with self-reported (or reported by roommate) sleep apneas, snoring, and leg restlessness ( $n = 6$ ) or with incomplete data ( $n = 4$ ) were excluded. The final analysis was performed on 45 subjects (82% of the subjects initially enrolled;  $n=25$ , 55.5% females; mean age  $49.7 \pm 16.7$  years) (Table 1).

Among the 61 subjects enrolled with OSAS those with clinical insomnia (ISI>15), leg restlessness

Table I. - Demographic description and summarizing data regarding all psychometric variables (mean  $\pm$  standard deviation-SD). OSAS: Obstructive Sleep Apnea Syndrome Legend: F= female, PSQI: Pittsburgh Sleep Quality Index, ISI: Insomnia Severity Index, FIRST: Ford Insomnia Response to Stress Test, DBAS: Dysfunctional Beliefs and Attitudes About Sleep Scale, DIRS: Daytime Insomnia Symptom Response Scale, SAS: Zung Self-Rating Anxiety Scale, BDI: Beck Depression Inventory; \* significance of the differences between subjects with insomnia vs healthy subjects, ° significance of the differences between subjects with insomnia vs OSAS.

Demographic description and summarizing data regarding all psychometric variables.

|                 | Healthy subjects | Subjects with OSAS | Subjects with insomnia | p value             |
|-----------------|------------------|--------------------|------------------------|---------------------|
| Age (years)     | 49.8 $\pm$ 13.9  | 58.1 $\pm$ 10.2    | 49.7 $\pm$ 16.7        | *p=.68<br>°p=.07    |
| Female gender % | 53.3             | 54.5               | 55.5                   | *p=.47<br>°p=.45    |
| PSQI            | 2.3 $\pm$ 1.5    | 8.4 $\pm$ 2.4      | 14.4 $\pm$ 3.7         | *p<.0001<br>°p=.004 |
| ISI             | 5 $\pm$ 2.6      | 9.0 $\pm$ 2.6      | 16 $\pm$ 4.9           | *°p=.02             |
| DBAS            | 13 $\pm$ 6.4     | 15.7 $\pm$ 7.4     | 83.4 $\pm$ 35.7        | *°p<.0001           |
| DIRS            | 26 $\pm$ 5.9     | 30.3 $\pm$ 5.2     | 56 $\pm$ 19.2          | *°p<.0001           |
| SAS             | 12.1 $\pm$ 4     | 30.2 $\pm$ 2.3     | 40.5 $\pm$ 8.1         | *p<.0001<br>°p=.01  |
| BDI             | 5.0 $\pm$ 2.4    | 5 $\pm$ 2.3        | 11.1 $\pm$ 7.8         | *°p<.0001           |

( $n=20$ ) or with incomplete data ( $n=8$ ) were excluded. The final analysis was performed on 33 subjects (54% of the subjects initially enrolled;  $n=18$ , 54.5% females; mean age 58.1 $\pm$ 10.2 years). Mean values of apnea/hypopnea index were 8.2 $\pm$ 1.3 indicative for mild forms.

Thirty subjects were enrolled as good sleepers ( $n=17$ , 56,6% females; mean age 49.8 $\pm$ 13.9 years). *Subjects with ID, OSAS and H controls did not differ regarding sex and age distribution. Subjects with insomnia showed significantly higher scores on all the scales compared to the other two groups as documented by higher scores on the PSQI, ISI, DBAS, DIRS, BDI and SAS (Table 1). In terms of BDI, in the insomnia group results indicated depressive symptoms in 11 patients (mean value 11 $\pm$ 7.8). Symptoms of anxiety were present in 10 individuals with insomnia (mean value 40.5 $\pm$ 8.1).*

Eleven subjects with OSAS showed a poor sleep (PSQI total score > 5) and five subjects showed symptoms of insomnia (ISI score  $\geq$  8) without showing clinical insomnia (mean values < 15) (Table 1).

*Italian version of DIRS:*

#### - Internal Consistency

The internal consistency of the Italian version of the DIRS in the insomnia subjects, in the healthy controls and OSAS subjects was evaluated using

Cronbach's  $\alpha$  coefficients. Results show that the overall Cronbach's  $\alpha$  (range of item-deletion  $\alpha$ ) coefficients were 0.96 (0.963-0.968) for the insomnia subjects, 0.73 (0.72-0.74) for the healthy controls and 0.75 (0.753-0.758) for OSAS subjects.

#### - Discriminant Validity

The scores of the Italian version of DIRS were significantly higher in the insomnia subjects than H controls and OSAS subjects (Table 1)

#### - Determinants of the DIRS in subjects with Insomnia Disorder

In the multiple regression model including the DIRS score as the dependent variable and age, sex, PSQI, ISI, DBAS, BDI and SAS as independent variables, unhelpful beliefs about sleep-DBAS ( $p=.004$ ) remained the only independent determinant (Table 2) (correlation  $p=0.63$   $p<.001$ , Figure 1).

#### - Determinants of the DIRS in subjects with Obstructive Sleep Apnea Syndrome

In a multiple regression model including the DIRS score as the dependent variable and age, sex, PSQI, ISI, DBAS, BDI and SAS as independent variables, *insomnia symptoms* ( $p=.02$ ) remained the only independent determinants of *sleep related* daytime rumination in the group of OSAS (Table 2).

Table II. - Determinants of Daytime Insomnia Symptom Response Scale. The results of the Spearman correlation analysis (**Rs**) between the Daytime Insomnia Symptom Response Scale (DISRS) and the other psychometric variables in the group of subjects Obstructive Sleep Apnea Syndrome (OSAS). The results of the multiple linear regression (B), considering DISRS as the dependent variable. Legend: PSQI: Pittsburgh Sleep Quality Index, ISI: Insomnia Severity Index, DBAS: Dysfunctional Beliefs and Attitudes About Sleep, BDI: Beck Depression Inventory, SAS: Zung Self-Rating Anxiety Scale Significant correlations in bold. \* =  $p < .05$ , \*\* =  $p < .01$ .

Determinants of Daytime Insomnia Symptom Response Scale.

|      | Subjects with OSAS |         | Subjects with Insomnia |         |
|------|--------------------|---------|------------------------|---------|
|      | coeff.             | p-value | coeff.                 | p-value |
| DIRS |                    |         |                        |         |
| PSQI | 0.2                | .50     | 0.5                    | .50     |
| ISI  | 0.9                | .02*    | 0.7                    | .20     |
| DBAS | 0.2                | .10     | 0.3                    | .004**  |
| BDI  | 0.3                | .30     | 0.5                    | .20     |
| SAS  | 0.03               | .35     | 0.1                    | .70     |

## Discussion

The present study investigated the daytime rumination activity in Insomnia Disorder and its possible relationship with other sleep related cognitive factors. To this aim, we assessed a sample of subjects with Insomnia Disorder, a group of good sleepers and, as a novel aspect, a group of subjects with another sleep disorder such as Obstructive Sleep Apnea Syndrome, by evaluating sleep related daytime rumination, while also controlling for psychiatric symptoms. We also provided analyses to test the internal consistency and the discriminant validity of the Italian version of the Daytime Insomnia Symptom Response Scale – DISRS, a specific tool to evaluate sleep related daytime rumination (Carney et al., 2013), that was used for the first time in an Italian sample of subjects. These data provided evidence that sleep related daytime rumination are a particular characteristic of insomnia subjects and that the association with cognitive processes such as, unhelpful beliefs about sleep, may be a feature of insomnia. Although the cross-sectional design of the study does not allow establishing the cause-effect relationship between variables, one may hypothesize that unhelpful beliefs about sleep may play a role in modulating sleep related daytime rumination in insomnia. The Italian version of the rating scale measuring sleep related daytime rumination-DISRS showed good internal consistency and good discriminant validity, thus confirming the data from previous studies about the questionnaire (Carney et al., 2013). Sleep related daytime rumination resulted to be higher in subjects with Insomnia Disorder with respect to subjects with another sleep disorder such

as Obstructive Sleep Apnea Syndrome and healthy controls; this evidence represents a novel aspect that has never been studied before.

Subjects with insomnia also showed a poorer sleep quality, higher insomnia severity and unhelpful beliefs about sleep when compared with the other two groups of subjects. While no insomnia subjects met *DSM-5 criteria (APA, 2013) for anxiety or depressive disorders, the sample showed some variability in both anxiety and depressive symptoms when compared with subjects with OSAS or healthy subjects, which was an expected result as insomnia, depression and anxiety are highly comorbid (Jansson-Fröjmark and Lindblom, 2008; Harvey, 2008; Baglioni, et al., 2011; Riemann, et al., 2015)* In subjects with Insomnia Disorder the only determinant of daytime rumination was sleep-interfering beliefs. Thus, with a low degree of unhelpful beliefs about sleep, one would expect a low rate of rumination about daytime insomnia symptoms. In contrast, in subjects with Obstructive Sleep Apnea Syndrome, daytime sleep related thoughts were more related to insomnia symptoms. As previously mentioned the cross-sectional design of the study does not permit to establishing the cause-effect relationship between variables, although, we may hypothesize that if OSAS subjects may have daytime sleep related thoughts, it may relate to insomnia symptoms and the effective consequences of the OSAS on daytime activity.

Thus, as a novel aspect, these findings may thus suggest that daytime rumination about sleep seems to be a cognitive construct closely related to the amount of sleep related unhelpful beliefs, in insomnia subjects. These data may confirm the hypothesis that

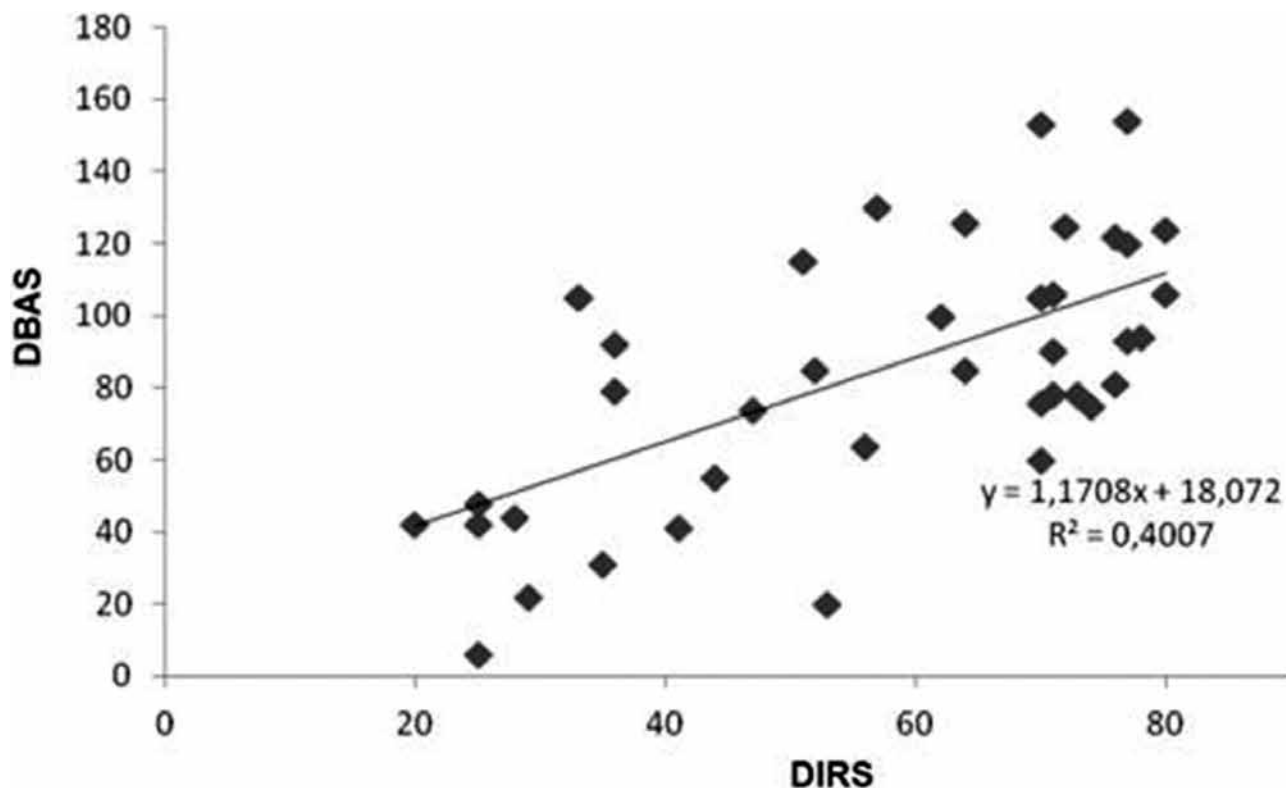


Fig. 1. - Correlation between DIRS and DBAS. A scatter plot of data attesting significant correlations between two psychometric variables, DIRS: Daytime Insomnia Symptom Response Scale and DBAS: Dysfunctional Beliefs and Attitudes About Sleep Scale.

considers insomnia disorder as a cognitive disorder throughout the 24-hour period (Harvey, 2002).

Also important is the fact that no relation was found between daytime sleep related rumination and depressive or anxiety symptoms. This finding may thus provide support for previous observances regarding rumination are not exclusively related to depression or anxiety symptoms (Gruber *et al.* 2008, Carney *et al.*, 2013), and it may be considered a transdiagnostic processes across disorders. Indeed, the present sample included subjects with insomnia and generally low levels of depression and anxiety and therefore restriction of range may have attenuated any potential relation between DIRS scores and psychopathology.

We should acknowledge several limitations of the study. These preliminary data were collected in the cross sectional design study: longitudinal studies are needed, recruiting larger populations of chronic insomniacs with various psychiatric and medical comorbidities. Future studies should also incorporate physiological measures of sleep and arousal.

*In conclusion, this study suggests that: i) in insomnia, daytime sleep related rumination is more frequent than in good sleepers and than in those with OSAS ii) in insomnia, the construct of daytime sleep related rumination is related to the cognitive construct of unhelpful sleep related beliefs. iii) These possible associations appear to be a feature of subjects with insomnia as in subjects with other sleep disorder, such as OSAS, daytime sleep related rumination may occur independently of cognitive construct.*

These data may confirm the hypothesis that considers insomnia disorder as a cognitive disorder throughout the 24-hour period (Harvey, 2002). As rumination seems to also be related to depression or anxiety symptoms (Gruber *et al.* 2008, Carney *et al.*, 2013) this cognitive activity may be considered a transdiagnostic processes across disorders (Gruber *et al.* 2008) If this finding will be confirmed in future research it should be useful to study therapeutic strategies acting on cognitive processes to prevent and treat insomnia disorder and its comobid conditions.



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