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## Relation between habitual sleep duration and depressed mood state: Somatic versus cognitive symptoms

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**ABSTRACT.** The present *ex post facto* prospective investigation analyses the association between habitual sleep duration and depressed mood state in college students. The sample was composed of 141 healthy students of both sexes, 19 with short sleep pattern (sleeping 6 hours or less per night), 64 with intermediate sleep pattern (sleeping 7-8 hours per night) and 58 with long sleep pattern (sleeping more than 9 hours per night). Depressed mood was evaluated with the Beck's Depression Inventory (BDI) and the depression subscale of the General Health Questionnaire (GHQ-28). The scores for depressed mood state were higher for individuals with short and long sleep pattern than for those with intermediate sleep pattern. The item analysis of specific depression symptoms indicated that short sleepers differ from intermediate sleepers in the somatic symptoms of depressed mood, whereas the differences between long and intermediate sleepers are observed in cognitive aspects. Some explicative hypothesis about the mechanisms that could be mediating relations between sleep duration and depressed mood are discussed. The development of educational initiatives destined to optimise students' sleep habits may be useful to prevent future depression.

**KEY WORDS.** Short sleep pattern. Intermediate sleep pattern. Long sleep pattern. Depressed mood state. *Ex post facto* study.

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**RESUMEN.** La presente investigación *ex post facto* analiza la relación entre la duración habitual de sueño y el estado de ánimo deprimido. La muestra estuvo compuesta por 141 estudiantes sanos de ambos sexos, 19 con patrón de sueño corto (6 horas de sueño diario o menos), 64 con patrón de sueño intermedio (7-8 horas de sueño diario) y 58 con patrón de sueño largo (más de 9 horas de sueño diario). El ánimo deprimido se evaluó con el Inventario de Depresión de Beck (BDI) y la subescala de depresión del Cuestionario de Salud General (GHQ-28). Los sujetos con patrón de sueño corto y largo mostraban puntuaciones superiores en ánimo deprimido que aquellos con patrón de sueño intermedio. El análisis de cada uno de los ítems de depresión específicos mostró que los sujetos con patrón de sueño corto diferían de los patrones de sueño intermedio en los síntomas somáticos de la depresión, mientras las diferencias entre los sujetos con patrón de sueño largo e intermedio se producían en aspectos cognitivos. Se presentan algunas hipótesis explicativas sobre los mecanismos que pueden estar mediando las relaciones entre duración de sueño y estado de ánimo deprimido. El desarrollo de iniciativas educacionales destinadas a optimizar los hábitos de sueño de los estudiantes puede ser útil para prevenir depresiones futuras.

**PALABRAS CLAVE.** Patrón de sueño corto. Patrón de sueño intermedio. Patrón de sueño largo. Estado de ánimo deprimido. Estudio *ex post facto*.

**RESUMO.** A presente investigação *ex post facto* analisa a relação entre a duração habitual do sono e o estado de humor deprimido. A amostra foi constituída por 141 estudantes saudáveis de ambos os sexos, 19 com padrão de sono breve (pelo menos 6 horas de sono diário), 64 com padrão de sono intermédio (7-8 horas de sono diário) e 58 com padrão de sono longo (mais de 9 horas de sono diário). O humor deprimido foi avaliado com o inventário de depressão de Beck (BDI) e a subescala de depressão do questionário de saúde geral (GHQ-28). Os sujeitos com padrão de sono breve e longo mostraram pontuações superiores no humor deprimido às daqueles com um padrão de sono intermédio. A análise de cada um dos itens de depressão específicos mostrou que os sujeitos com padrão de sono breve diferiam dos que tinham um padrão de sono intermédio nos sintomas sintomáticos da depressão, enquanto que as diferenças entre os sujeitos com padrão de sono longo e intermédio se produziam em aspectos cognitivos. Apresentam-se algumas hipóteses explicativas sobre os mecanismos que podem estar a mediar as relações entre duração do sono e o humor deprimido. O desenvolvimento de iniciativas educacionais destinadas a otimizar os hábitos de sono dos estudantes pode ser útil para prevenir depressões futuras.

**PALAVRAS CHAVE.** Padrão de sono breve. Padrão de sono intermédio. Padrão de sono longo. Estado de humor deprimido. Estudo *ex post facto*.

### Introduction

The areas in which interesting connections can be established between sleep and health are increasingly numerous. With reference to habitual sleep duration, there is usually a distinction made between subjects designated as having short sleep pattern (sleeping 6 hours or less per day), subjects with intermediate sleep pattern (sleeping 7-

8 hours per day) and subjects with long sleep pattern (sleeping 9 or more hours per day). The reason for these individual differences in sleep duration is unknown and it is still debatable as to whether 7 or 8 hours of sleep is, in fact, ideal in terms of physical and mental well being or, on the contrary, each person needs to satisfy their "individual quota of sleep" as suggested by Hartmann (1973) or even, sleep can be permanently reduced (1 or 2 hours) from these "ideal 7-8 hours" without negative consequences upon physical or psychosocial functioning.

Several studies have been carried out in order to establish possible differences on psychological and physiological variables according to sleep pattern. It has recently been suggested that sleeping for less time and also, paradoxically, for more of the time associated with intermediate sleep pattern has a negative effect on physical health (for a review see Miró, Iáñez, and Cano-Lozano, 2002). For example, in the pioneer study conducted by Kripke, Simons, Garfinkel, and Hammond in 1979, and later re-evaluated by Kripke, Garfinkel, Wingard, Klauber, and Marter (2002), they reported on a survey carried out by the American Cancer Society on more than one million people of all age ranges (from 30 to 102 years old). The objective of this study was to identify risk factors for cancer although it included questions about sleep habits and by coincidence, a surprising relationship was demonstrated. After 6 years, it was identified which people who took part in the survey had died, and after checking the possible influence of mediating factors such as age, diet, exercise, medication taken, sleep disorders, etc., minimum mortality was found in the subjects who slept for around 7 hours. Relative mortality risk increased above 8 hours of daily sleep and, particularly, below 6 hours. The great part of current investigations equally observe that the deviation of intermediate sleep pattern is associated with worse physical health (Bliwise, King, and Harris, 1994; Mahon, 1995; Qureshi, Giles, Croft, and Bliwise, 1997); higher risk of mortality (Kojima *et al.*, 2000); or higher risk of developing coronary events or diabetes over a 10 year longitudinal study (Ayas *et al.*, 2003). As Sotos (2003) states, these studies support the 2000-year-old clinical experience of Hipocrates when noted that "Both sleep and insomnolency, when immoderate, are bad".

Results about other possible areas of difference between sleep patterns are much less clear. One important question which has been scarcely researched is whether different sleep patterns are distinctive in terms of psychological health. Poor sleep quality has been consistently correlated to the presence of psychological disturbance both in clinical samples (McAlpine and Wilson, 2004; Ohayon and Zulley, 2001) and in samples of healthy subjects (Moo-Estrella, Pérez-Benitez, Solís-Rodríguez, and Arankowsky-Sandoval, 2005; Pilcher, Ginter, and Sadowsky, 1997). However, the relation between habitual sleep duration in healthy subjects and psychological health has not been so conclusive. Classical studies made by Hartmann, Baekeland, and Zwillling (1972) suggest that subjects with short sleep pattern were people who were more satisfied with their lives, efficient, competitive and extrovert, whereas those with long sleep pattern were more neurotic, introvert, depressive, critical and creative. Some later works follow along these lines by observing that individuals with short sleep pattern cope with the stress more efficiently (Hicks, Marical, and Conti, 1991); higher percentages of type A conduct patterns (McKelvie, 1992); or lower scores in anxiety and neuroticism than the subjects

with long sleep pattern (Chattopadhyay and Dasgupta, 1992). Nevertheless, in the majority of investigations which focused on aspects of personality or anxiety, no differences were found between the subjects with short and long sleep patterns (Buela-Casal, Sierra, and Caballo, 1992; Gray and Watson, 2002; Vera-Villaruel, Sánchez, Rivera, and Buela-Casal, 2000).

The aspect which has attracted most attention is probably depression. Breslau, Roth, Rosenthal, and Andreski (1997) in a follow up study over a period of 3 years with a sample of 979 young people, found that the risk of developing major depression was four times higher when there was a previous history of insufficient sleep rather than if the sleep duration was normal or even long. Other studies have found associations between the presence of long sleep duration and risk of suffering from depression later on (Ford and Kamerow, 1989). Chang, Ford, Mead, Cooperpatrick, and Klag (1997) tried to establish the relationship between sleep characteristics in a sample of 1053 subjects in the period in which the subjects were students and the appearance of psychological disorders in a follow up investigation over a period of 34 years. The risk of developing clinical depression was much higher (2.3) in the subjects who habitually slept less than 7 hours or had insomnia than in those with a normal sleep pattern (.9). However, in this series of studies the presence of sleep disorders is not well differentiated from sleep patterns and, therefore, they all combine “authentic” short, intermediate or long sleepers with subjects who have sleep problems. Please note that, by definition, sleep patterns must not have the perception of unsatisfactory, inadequate or non-restorative sleep, nor present sleep problems.

To the best of our knowledge, only two studies upon psychological well being have made a careful selection of sleep patterns to be included. Specifically, Monk, Buysse, Welsh, Kennedy, and Rose (2001) compared 12 adult short sleepers with 12 long sleepers in morningness-eveningness, extroversion, neuroticism, sleepiness, depression, exercise habits and work. No significant differences were observed in any of these aspects, with the exception of some evidence of hypo-mania symptoms in the subjects with a short sleep pattern. Wu, Zhang, Wu, and Long (2001) analyzed the personality characteristics of 15 adult short sleepers, 15 subjects with insomnia and 15 subjects without sleep problems. They observed that the subjects with short sleep pattern have higher scores in hypo-mania and lower scores in social introversion than the insomniacs and the subjects who are problem free. Moreover, their scoring in hypochondriasis, depression, hysteria and psychasthenia was lower than that of those subjects suffering from insomnia but was not different from the scores of the problem free subjects. Unfortunately, these investigations have not included an overall form to represent each one of the sub-types of sleep patterns which would contribute to obtain an overview of clearer results.

The aim of this investigation is to examine if sleep pattern (short sleep pattern, intermediate sleep pattern or long sleep pattern) has a relationship with the depressed mood and, if this is so, to analyse if the type of disturbance observed in depressed mood is similar within the different sleep patterns, or, on the other hand, it possesses differential characteristics.

## Method

### *Sample*

141 healthy volunteers (107 women and 34 men) participated in the study with an age range of 17 to 29 years ( $M = 20.54$  and  $SD = 2.72$ ). This sample was chosen among the total of 636 psychology students by means of a questionnaire elaborated for this purpose. The questionnaire explored such areas as physical and psychological health, consumption of tobacco, medication, alcohol and other drugs, regularity in sleep schedules, presence of daytime sleepiness or fatigue, and the possible existence of sleep disorders. The Horne and Östberg Morningness-Eveningness Scale (Horne and Östberg, 1976) for determining each subject's circadian type and the Symptom Checklist-90-Revised (Derogatis, Rickels and Rock, 1976) for determining general psychopathology were administered along with the selection questionnaire. The exclusion criteria consisted of belonging to an extreme circadian type, morning-type or evening-type, self-reported daytime sleepiness or fatigue, and the presence of sleep disorders, medical or psychological problems, consumption of medication or drugs.

The selected individuals were divided into three groups according to the number of hours habitually slept in order to feel well during the day: a) Subjects with short sleep pattern who habitually sleep less than 6 hours per night ( $n = 19$ , 15 women and 4 men), b) Subjects with intermediate sleep pattern who sleep 7-8 hours per night ( $n = 64$ , 43 women and 21 men) and finally, c) Subjects with long sleep pattern who habitually sleep more than 9 hours per night ( $n = 58$ , 49 women and 9 men). Subjects were instructed to respond in relation to their habitual sleep patterns, not in isolated days. It was decided that within the long sleep pattern only those who slept more than 9 hours would be included, not only because this had been the most common definition criteria used in literature written about this subject, but also because optimum sleep duration may undergo variations according to age, and it has been pointed out that in adolescents and young adults, such duration may be located between 8-9 hours (Bjorkelund, Bengtsson, Lissner, and Rodstrom, 2002; Carskadon, 1993).

### *Instruments*

- The Beck Depression Inventory (BDI) (Spanish version by Vázquez and Sanz, 1997). This instrument consists of 21 items (each one of them having 4 stated responses) that describe depressive symptoms. The subject indicates the state which best describes their current condition. Each item is scored from 0 to 3 and the total scoring range obtained in the inventory oscillates from 0-63. The BDI was chosen not only for its proven psychometric properties in different populations, but also for the possibility of applying it to non-clinical settings in which subjects who suffer from depressed mood can be effectively identified (Spielberger, Carretero-Dios, Santos-Roig, and Buela-Casal, 2002a; Spielberger, Carretero-Dios, Santos-Roig, and Buela-Casal, 2002b).
- The General Health Questionnaire (GHQ-28) (Spanish version by Lobo, Perez-Echevarria, and Artal, 1986). This instrument allows the evaluation of two kinds of current problems: inability to carry out one's usual healthy activities and the

manifestation of discomfort symptoms related with a state of tension. It is composed of 28 items grouped in four subscales consisting of 7 items for each one: somatic symptoms, anxiety and insomnia, social dysfunction and severe depression. The subject underlines the chosen answer for each item (which is scored on Likert format from 0 to 3 points) according to how they have felt during the last few weeks. In this study we solely focus on the subscale for severe depression. Recent data support the cross-cultural validity of the GHQ-28 and reinforce its position as one of the most widely used screening instrument for general psychopathology (Gibbons, Flores, and Mónico, 2004).

#### *Procedure*

The investigation was carried out in a laboratory which was divided into two rooms communicated by a door and a one-way glass window. The room temperature in both areas was maintained at a thermo-neutral level (22-25 °C), the lighting was constant, and these areas were isolated from any noise. Data recollection took place during the months of March, April and May 2004, coinciding with a period of academic activity, but not with exams. The participants were given individual appointments on Tuesdays, Wednesdays and Thursdays from 12:00 a.m. to 2:00 p.m. An informed consent was obtained for all subjects after the nature of the protocol was explained. Then each subject was placed in a room with psychophysiological recording and computing equipment in which various psychophysiological and performance parameters were registered (this parameters will be reported in other publication). Immediately afterwards, in the adjoining room, each subject completed a brief sleep register (quantity and quality of sleep during the previous night), the State-Trait Anxiety Inventory (STAI) (which has not been taken into consideration here), the Beck Depression Inventory (BDI), and the General Health Questionnaire (GHQ-28). The presentation order of these scales was always the same. The total time to complete all the foregoing protocol was approximately 32 minutes. The study fulfilled the standards of ethics established by the University of Granada. The article was elaborated according to the criteria and guidelines for the preparation of original research manuscripts proposed by Ramos-Álvarez, Valdés-Conroy, and Catena (2006).

#### *Data analysis*

The statistical analysis of the effects produced by the sleep pattern upon the different dependant variables was carried out by means of the statistical program SPSS 10.0. Two variance analyses (ANOVA), of one sole factor manipulated between groups on three levels (short, intermediate and long sleep patterns), were made with the purpose of determining if the sleep patterns differed in their global scores for depression on the BDI and in the GHQ-28. In case of ANOVA being significant, the analysis of the differences was carried out by means of post hoc comparisons, using Fisher's minimum significant difference test. Moreover, a specific analysis of each one of the items in the BDI and the GHQ-28 will be carrying out to determine significant differences according to sleep patterns. The items which turned out to be significant in this analysis were also subjected to *post hoc* comparisons using Fisher's minimum significant difference test.

According to the classification of Montero and León (2005) the study is a single and prospective *ex post facto* investigation.

### Results

#### *BDI Depression*

The unifactorial ANOVA for BDI global punctuations showed significant differences in depression according to sleep pattern,  $F_{(2, 138)} = 4.77, p < .01$ . The results of the *post hoc* comparisons indicated that the scores for depression in the individuals with short ( $M = 8.21, SD = 6.24$ ) and long sleep patterns ( $M = 7.43, SD = 7.47$ ) were significantly higher than those of the group of subjects with intermediate sleep pattern ( $M = 4.48, SD = 4.40$ ) (see Table 1 and Figure 1). There were no significant differences in depression between the extreme groups, that is, between subjects with short and long sleep patterns.

**TABLE 1.** Unifactorial ANOVA and *post hoc* analysis for depression scores on the BDI and the GHQ-28 according to sleep patterns.

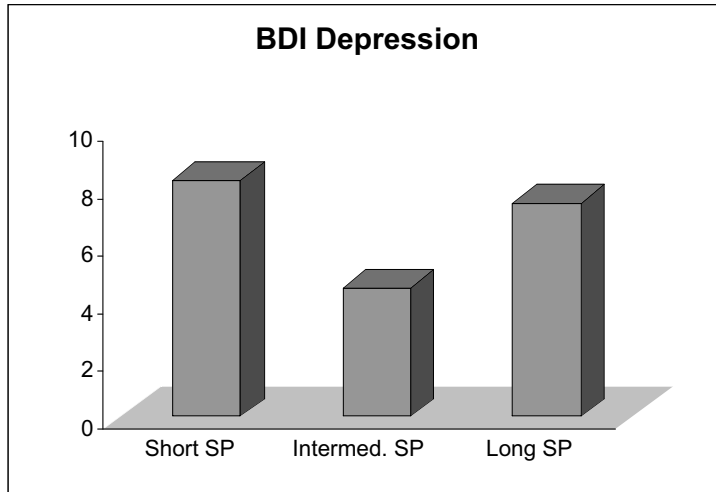
	SSP	ISP	LSP	F	p	Comparisons	p
BDI	M = 8.21	M = 4.48	M = 7.43	4.77	.01	SSP-ISP*	.02
Depression	SD = 6.24	SD = 7.47	SD = 4.40			SSP-LSP	.62
						ISP-LSP**	.00
GHQ-28				5.66	.00	SSP-ISP*	.02
Severe	M = 2.63	M = 1.00	M = 2.55			SSP-LSP	.91
depression	SD = 3.28	SD = 1.67	SD = 3.45			ISP-LSP*	.00

\*  $p < .05$  \*\*  $p < .01$

SSP: short sleep pattern, ISP: intermediate sleep pattern, and LSP: long sleep pattern.



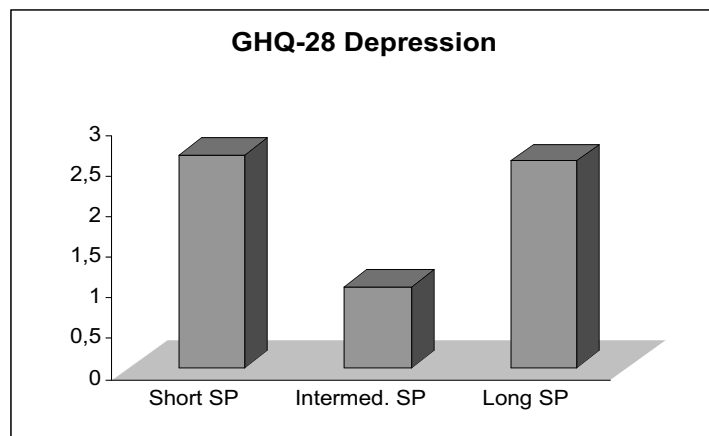
**FIGURE 1.** Graphic representation of Beck Depression Inventory (BDI) scores according to sleep pattern (*short, intermediate and long sleep pattern*).



*GHQ-28 severe depression*

The ANOVA revealed significant differences on severe depression according to sleep pattern,  $F_{(2, 138)} = 5.66, p < .01$ . The Fisher test showed significant differences between subjects with intermediate sleep pattern and those with short sleep pattern, and between subjects with intermediate and long sleep pattern. As in the case of BDI depression, subjects with intermediate sleep pattern obtained lower scores in severe depression on the GHQ-28 ( $M = 1.00, SD = 1.67$ ) than those who presented a short ( $M = 2.63, SD = 3.28$ ) or long sleep pattern ( $M = 2.55, SD = 3.45$ ) (see Table 1 and Figure 2). No significant differences were found between subjects with short and long sleep patterns.

**FIGURE 2.** Graphic representation of General Health Questionnaire (GHQ-28) scores according to sleep pattern (*short, intermediate and long sleep pattern*).



#### *BDI items analysis*

Univariate ANOVAs for each one of the BDI 21 items indicated significant differences according to sleep pattern in twelve items (see Table 2). Please note that in item 11,  $F_{(2, 138)} = 2.62, p = .07$ , and in item 15,  $F_{(2, 138)} = 2.78, p = .06$ , only marginal significant differences were found according to sleep pattern. In these items also the *post hoc* comparisons were applied. In such cases it may be preferable to decrease the rate of Type II error, impeding the rejection of the existing differences. No significant differences were found according to sleep pattern in items related to pessimism (item 2), loss of pleasure (item 4), self-criticalness (item 8), suicidal thoughts (item 9), loss of interest (item 12), indecisiveness (item 13), worthlessness (item 14), loss of appetite (item 18) and hypochondria (item 20).

The *post hoc* comparisons, for each one of the BDI items in which the ANOVA was significant, showed that the subjects with short sleep pattern present significantly higher mean scores than the subjects with intermediate sleep pattern in items relating to somatic aspects as crying (item 10 = .68 vs. .17), insomnia (item 16 = .89 vs. .37), loss of weight (item 19 = .53 vs. .11) and loss of interest in sex (item 21 = .37 vs. .08). On the other hand, the group with long sleep pattern showed significantly higher mean scores than the subjects with intermediate sleep pattern in items relating to cognitive aspects as sadness (item 1 = .43 vs. .23), past failure (item 3 = .26 vs. .08), guilty feelings (item 5 = .46 vs. .19), self-dislike (item 7 = .21 vs. .05), irritability (item 11 = .53 vs. .31), work incapacity (item 15 = .58 vs. .35) and fatigue (item 17 = .53 vs. .25). Only in item 6 (punishment feelings) the subjects with long sleep pattern obtain lower scores (.15) than those with intermediate sleep pattern (.47). Finally, the subjects with short sleep pattern scored significantly higher than the subjects with long sleep

pattern in crying (item 10 = .68 vs. .34), insomnia (item 16 = .89 vs. .58) and loss of weight (item 19 = .52 vs. .19). In item 17 which relates to fatigue, the subjects with short sleep pattern informed that they experienced less fatigue (.21) than individuals with long sleep pattern (.53).

**TABLE 2.** ANOVAs and *post hoc* comparisons for the BDI items in function of sleep pattern.

BDI significant items	Mean SSP	Mean ISP	Mean LSP	F	p	Comparisons	p
Item 1. Sadness	.31	.23	.43	2.89	.05	SSP-ISP	.58
						SSP-LSP	.45
						ISP-LSP*	.06*
Item 3. Past failure	.19	.08	.26	3.13	.05	SSP-ISP	.10
						SSP-LSP	.96
						ISP-LSP*	.02*
Item 5. Guilty feelings	.33	.19	.46	3.87	.05	SSP-ISP	.21
						SSP-LSP	.51
						ISP-LSP**	.00**
Item 6. Punishment feelings	.30	.47	.15	2.91	.05	SSP-ISP	.19
						SSP-LSP	.97
						ISP-LSP*	.07*
Item 7. Self-dislike	.16	.05	.21	3.26	.05	SSP-ISP	.22
						SSP-LSP	.59
						ISP-LSP**	.01**
Item 10. Crying	.68	.17	.34	4.37	.01	SSP-ISP**	.00**
						SSP-LSP*	.05*
						ISP-LSP	.15
Item 11. Irritability	.41	.31	.53	2.62	.07	SSP-ISP	.54
						SSP-LSP	.53
						ISP-LSP*	.07*
Item 15. Work incapacity	.44	.35	.58	2.78	.06	SSP-ISP	.53
						SSP-LSP	.48
						ISP-LSP*	.05*
Item 16. Insomnia	.89	.37	.58	4.98	.01	SSP-ISP**	.00**
						SSP-LSP*	.07*
						ISP-LSP	.09
Item 17. Fatigue	.21	.25	.53	5.74	.01	SSP-ISP	.76
						SSP-LSP*	.01*
						ISP-LSP**	.00**
Item 19. Loss of weight	.53	.11	.19	5.05	.01	SSP-ISP**	.00**
						SSP-LSP**	.00**
						ISP-LSP	.49
Item 21. Loss of interest in sex	.37	.08	.19	3.22	.05	SSP-ISP**	.01**
						SSP-LSP	.13
						ISP-LSP	.17

\*  $p < .05$  \*\*  $p < .01$

*GHQ-28 item analysis*

Univariate ANOVAs for each one of the GHQ-28 items showed significant differences in item 1,  $F_{(2, 138)} = 6.14, p < .01$ ; in item 2,  $F_{(2, 138)} = 4.51, p = .01$ ; and in item 3,  $F_{(2, 138)} = 4.28, p = .01$ . There are nearly significant differences in item 6,  $F_{(2, 138)} = 2.78, p = .06$ . There are no significant differences according to sleep patterns in the item 4 (“Thought of the possibility that you might make away with yourself”), item 7 (“found that the idea of taking your own life kept coming into your mind”) and item 5 (“found at times you couldn’t do anything because your nerves were too bad”). As was also found in the case of the BDI, the comparisons showed that the subjects with long sleep pattern obtained higher mean scores than the subjects with intermediate sleep pattern in items related to cognitive aspects, such as “been thinking of yourself as a worthless person” (item 1 = .53 vs. .45), “felt that life is entirely hopeless” (item 2 = .36 vs. .31), “felt that life isn’t worth living”(item 3= .34 vs. .21) and “found your self wishing you were dead and away from it all” (item 6 = .26 vs. .21) (see Table 3). The remaining comparisons between short and intermediate sleep patterns, and short and long sleep patterns, were found not to be significant.

**TABLE 3.** ANOVAs and *post hoc* comparisons of GHQ-28 items in function to .11.

<i>GHQ-28 significant items</i>	<i>Mean SSP</i>	<i>Mean ISP</i>	<i>Mean LSP</i>	<i>F</i>	<i>p</i>	<i>Comparisons</i>	<i>p</i>
Item 1. Been thinking of yourself as a worthless person	.50	.45	.53	6.14	.01	SSP-ISP	.08
						SSP-LSP	.62
						ISP-LSP**	.00**
Item 2. Felt that life is entirely hopeless	.34	.31	.36	4.51	.01	SSP-ISP	.09
						SSP-LSP	.74
						ISP-LSP**	.00**
Item 3. Felt that live isn't worth living	.29	.21	.34	4.28	.01	SSP-ISP	.31
						SSP-LSP	.31
						ISP-LSP**	.00**
Item 6. Found your self wishing you were dead and away from it all	.21	.11	.26	2.78	.06	SSP-ISP	.09
						SSP-LSP	.61
						ISP-LSP*	.06*

\*  $p < .05$  \*\* $p < .01$

**Discussion**

Habitual sleep duration in healthy university students shows a relationship with the presence of depressed mood state. Short and long sleep durations are associated with increased sub-syndromal depressive symptoms in both the BDI and the subscale for severe depression of the GHQ-28. These results are in accordance with the findings of several transversal and longitudinal studies reporting that the risk of suffering from depression and other mental health problems is higher in subjects who sleep less than 7 hours or who have insomnia, as well as in subjects with hypersomnia (Breslau *et al.*,

1997; Chang *et al.*, 1997; Ford and Kamerow, 1989; Liu and Zhou, 2002). Unfortunately, to the best of our knowledge, only two investigations about depressed mood had selected subjects with a short, intermediate or long sleep pattern (without combining them with subjects having sleep problems) (Monk *et al.*, 2001; Wu *et al.*, 2001), and these studies have not included a representation of each one of the sleep patterns which limits comparisons with our results.

Wu *et al.* (2001) found that the scores for depression in short sleepers did not differ from those of normal subjects although they were lower than the scores obtained by a group of insomniacs, which does not seem to coincide with our results. However, it is not clear if the subjects designated as “normal” had an intermediate sleep pattern or were simply subjects “without sleep problems”. This aspect would be problematic when looking for significant differences between “normal” subjects (that combines intermediate and long sleep patterns) and short sleepers. Please note that in our work, no significant differences were observed in depressed mood between the extreme groups, that is to say, between the subjects having short or long sleep patterns. The same result was reported by Monk *et al.* (2001) on comparing short and long sleepers in diverse psychological measures, including depressed mood. This prevailing trend has been highlighted in other researches in which U-shaped relationships have been observed between habitual sleep time and variables of physical or psychological health (Grandner and Kripke, 2004; Kripke *et al.*, 2002; Miró Iáñez, *et al.*, 2002). Moreover, when differences between short and long sleepers are found, short sleepers are usually more affected (Ayas *et al.*, 2003; Breslau *et al.*, 1997; Liu and Zhou, 2002; Qureshi *et al.*, 1997).

The detailed analysis of each one of the BDI and GHQ-28 items offers new and interesting information about the kind of depressed mood state which characterizes short and long sleepers. Short sleepers reported greater mean scores in somatic symptoms, whereas long sleepers report greater mean scores in cognitive symptoms. To be specific, short sleepers scored higher than intermediate sleepers in the BDI items relating to crying, insomnia, loss of weight and loss of interest in sex. The only differences between short and long sleepers were also observed in somatic aspects. However, in the BDI item relating to fatigue, short sleepers reported less fatigue than long sleepers. No significant differences were observed in the GHQ-28 between short sleepers and the remaining sleep patterns, which is logical if we take into account that this instrument almost exclusively includes items referring to cognitive symptoms (Lobo *et al.*, 1986). There are no available studies which could be used to compare these results. Hicks reported that short sleepers have a higher frequency of headaches than long sleepers (Hicks and Kilcourse, 1983), and more likely to show abnormal eating patterns than the long sleepers (Hicks and Rozette, 1986). A recent study shows that sleep loss and REM sleep loss are hyperalgesic (Roehrs, Hyde, Blaisdell, Greenwald, and Roth, 2006), which to some extent could suggest that short sleepers are more likely to suffer from somatic symptoms. Equally, short sleepers had been characterised as people having a higher percentage of type A behavior (McKelvie, 1992) and a propensity to hypomania (Monk *et al.*, 2001; Wu *et al.*, 2001), which could be seen as coherent with our result of less fatigue reported by the short sleepers. However, none of these studies have analysed depressed mood state.

Long sleepers scored higher than intermediate sleepers in BDI items relating to sadness, past failure, guilty feelings, self-dislike, irritability, work incapacity and fatigue. On the GHQ-28, long sleepers obtained also higher scores than intermediate sleepers in items related to cognitive aspects such as “been thinking of yourself as a worthless person”, “felt that life is entirely hopeless”, “felt that life isn’t worth living” and “found your self wishing you were dead and away from it all”. As previously, there is a lack of studies with which to compare these results. To a certain extent, perhaps they seem coherent with the initial descriptions made by Hartmann *et al.* (1972) and Hartmann (1973) of long sleepers being depressive, worriers and withdrawn.

To sum up, short and long habitual sleep durations are associated with increased depressed mood. Individuals with short sleep pattern reported greater somatic symptoms of depression, whereas individuals with long sleep pattern reported greater cognitive symptoms. In addition, the finding of no significant differences between short and long sleepers in cognitive aspects (and the existence of differences in some of the somatic symptoms) suggests that short sleepers present somatic symptoms and some cognitive symptoms of depression, whilst long sleepers show almost exclusively cognitive symptoms. A similar model has been observed in epidemiological research on depression. Subjects who met overall diagnostic criteria for depression and presented fatigue and appetite and sleep disturbance were thought to have “somatic depression” and those who met overall criteria but did not show these somatic symptoms were thought to have endogenous, cognitive or “pure depression” (Silverstein, 2002). In fact, appetite disturbance, sleep disturbance, fatigue and anxiety never load highly on the endogenous factor reported in factor analytic studies of depressive symptoms (Silverstein, 2002). However, the exact nature of depression is complex and indeterminate phenomenon to a great extent, and this affects its evaluation and the development of efficient intervention techniques (Dowd, 2004; Spielberger, Ritterband, Reheiser, and Brunner, 2003).

In this study, the scores of depressed mood, although statistically significant, are located within non-clinical boundaries, as was to be expected in the case of a sample of healthy university students. It is evident that numerous psychological factors have shown to be implicated in mood alterations (e.g., Maldonado, Pérez-Ocón, and Herrera, 2007; Peñate, Perestelo, and Bethencourt, 2004). Sleep processes could be one of the factors that contribute to the appearance of mood disorders. However, it is unclear how sleep pattern differences might be related to psychological or biological changes that could affect mood and health. It could be hypothesized that perhaps, subjects with short sleep pattern are chronically sleep deprived. Many authors have warned about the consequences of chronic sleep restriction due to current lifestyle (Iglowstein, Jenni, Molinari, and Largo, 2003; Splegel, Leproult, and Van Cauter, 1999). For example, studies which compare habitual sleep duration in young people in 1963 with those from 1910-1911 (Carskadon, 1993); and from the period of 1974 until the present time (Iglowstein *et al.*, 2003) found a total reduction in sleep time of approximately one hour and a half. The negative effects upon a wide range of physiological, cognitive, behavioural and emotional measurements both of partial sleep restriction (Belenky *et al.*, 2003; Swann, Yelland, Redman, and Rajaratnam, 2006) and total sleep deprivation, during a period of one or two nights, have been widely documented (Beutler, Cano, Miró, and Buela-Casal, 2003; Miró, Cano-Lozano, and Buela-Casal, 2002).

A possible explanation of what may be occurring in subjects with long sleep pattern is less obvious. In earlier research by Hartmann (1973) the characteristics of long sleepers were analysed by trying to relate them to the higher quantity of REM sleep which would be obtained sleeping more time. REM sleep has been associated with mood regulation (Carskadon, 1993; Cartwright, Young, Mercer, and Bears, 1998). At polysomnographic level (PSG) the subjects with long sleep pattern present greater quantities of phases 1, 2 and REM sleep, and less quantity of slow wave sleep (phases 3 and 4) than the remaining sleep patterns. If depressed mood state characteristics of long sleepers are attributable to an excess of REM or to other sleep peculiarities this must be further investigated. For example, it is not known what consequences can be associated with experiencing inferior quantities of slow wave sleep that perform important functions in restoring prefrontal cortex (PFC), a vital cerebral area for daily functioning also involved in mood regulation (Richert, Carrion, Karchemski, and Reiss, 2006; Silva and Slachevsky, 2005).

In reality, the present study does not allow to determine if the habitual sleep duration has some causal effect on the depressed mood. After all, the long or short sleep duration could be the by-product of the depressed mood or the any other factor that could influence both sleep and mood. Future longitudinal research may contribute to the clarification of these relations. Moreover, although sleep patterns are highly stable in time and can be well evaluated with subjective measures (Aeschbach *et al.* 2001; Armitage, Trivedi, Hoffman, and Rush, 1997) the inclusion of objective measurements in future research will be necessary to clarify the subjacent mechanisms. Sleep could be an excellent indicator of the state of health both in the general population and in psychiatric patients. Early interventions targeting sleep habits might be useful in preventing future mood disorders. This assumption is not incompatible with some individual variability that may exist with reference to sleep duration, although within certain limits (probably from 6 to 9 hours) that would correspond to the intermediate sleep pattern.

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