

Patients with Delayed Sleep-Wake Phase Disorder sleep less during Daylight Saving Time

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INTRODUCTION

- Due to time zones, sun time and local time rarely match. The difference between Local And Sun Time (Δ LAST) depends on location within a time zone and can range from zero to several hours. Daylight Saving Time (DST) simply adds one more hour to Δ LAST, independent of location^{1,2}.
- Chronobiology and sleep researchers have highlighted the negative consequences of DST to health.
- Delayed Sleep-Wake Phase Disorder (DSWPD) is one of the most common among circadian sleep-wake disorders, characterised by a 'significant delay in the phase of the major sleep episode in relation to the desired or required sleep time and wake-up time'³.
- We hypothesized that patients with Delayed Sleep-Wake Phase Disorder (DSWPD) suffer from sleep deficits during DST.

METHODS

- We analyzed clinical records of 162 DSWPD patients (52.5% male; median [Q1, Q3] age: 35.5 [26.0, 50.3]; age range:16-92) from a Centre for Sleep Medicine in Lisbon, Portugal (GMT zone).
- Dim Light Melatonin Onset (DLMO) was measured as a marker for circadian phase in 82 patients (54 from DST and 28 in ST) and we calculated the phase angle difference between DLMO and Sleep Onset (SO), Mid-sleep (MS) and Sleep End (SE) on work- (w) and work-free days (f).
- ST and DST data were compared using Mann-Whitney or Student's t tests. The association between Δ LAST and SO_w was assessed using Spearman's correlation. Δ LAST was computed using the R package "solartime". Analyses were performed with SPSS v.27 and R; the significance level was set at 5%.

RESULTS

Table 1. Summary of demographic data, sleep, and biological phases of DSWPD in standard time (ST) and daylight-saving Time (DST)

	DST	ST	P-value
Sample size	54	28	
Age (years) - median [IQR]	34.00 [26.00, 42.75]	36.00 [23.75, 50.00]	0.777
Sex: male - n (%)	33 (61.1)	12 (42.9)	0.180
Workdays per week (n) - median [IQR]	5.00 [5.00, 5.00]	5.00 [5.00, 5.00]	0.985
MSF _{sc} (h) - median [IQR]	7.54 [6.58, 8.55]	8.25 [6.57, 9.13]	0.226
Weekly sleep duration (h) - median [IQR]	6.77 [5.73, 7.48]	7.39 [6.81, 9.00]	0.004
Social jetlag (h) - median [IQR]	1.38 [0.00, 2.50]	0.75 [0.00, 2.02]	0.373
DLMO (h) - median [IQR]	1.92 [0.18, 2.55]	1.13 [-1.18, 6.41]	0.197
Phase angles			
SO_w - DLMO [mean (SD)]	1.68 (1.28)	2.08 (1.59)	0.224
SO_f - DLMO [mean (SD)]	2.50 (1.38)	2.81 (1.81)	0.374
SE_w - DLMO [mean (SD)]	7.87 (1.89)	9.53 (2.14)	<0.001
SE_f - DLMO [mean (SD)]	10.03 (2.15)	11.11 (1.90)	0.027
MSW - DLMO [mean (SD)]	4.84 (1.33)	5.80 (1.68)	0.005
MSF - DLMO [mean (SD)]	6.18 (1.57)	7.05 (1.74)	0.025
MSF _{sc} - DLMO [mean (SD)]	5.89 (1.56)	6.72 (1.81)	0.045

Mann-Whitney, t-Test or Chi-square according to data distribution. DSWPD – Delayed Sleep-Wake Phase Disorder; DLMO – Dim Light Melatonin Onset; IQR – interquartile range (reported as Q1 and Q3); MSF_{sc} – mid-point of sleep on free-days sleep corrected; SO_w – sleep onset on workdays; SO_f – sleep onset on free days; SE_w – sleep end on workdays; SE_f – sleep end on free days; MSW – mid-sleep point on workdays; MSF – mid-sleep point on free-days; For MSF_{sc}, the samples are n = 25 (ST) and 49 (DST) due to the use of alarm clock on free days; All time values presented are given in local time

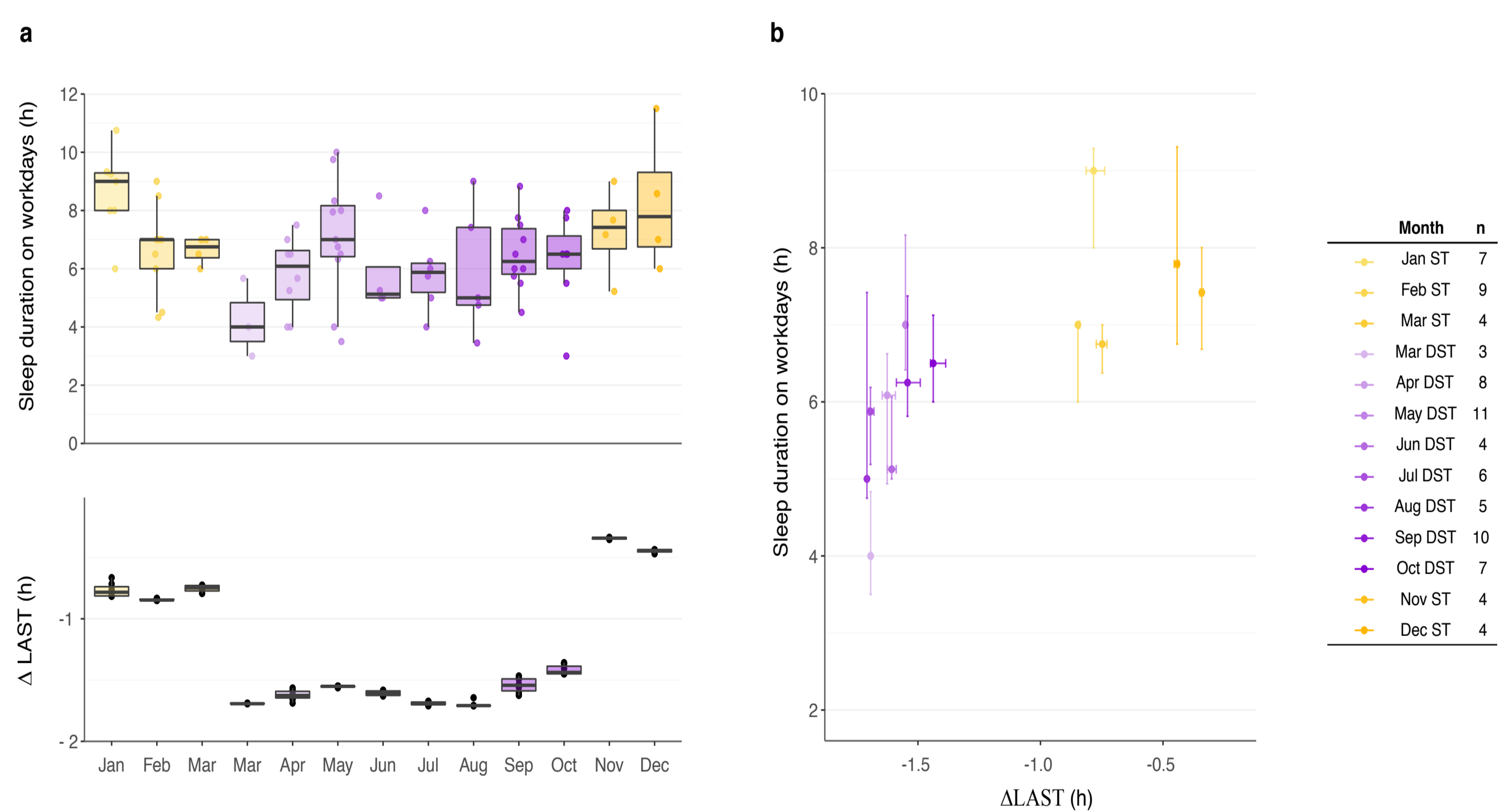


Figure 2. Relationship between sleep duration on workdays and the difference between local time and sun time. (a) Sleep duration on workdays and Δ LAST by month throughout the year; (b) Relationship between sleep duration on workdays and the Δ LAST. Values are presented by month and data are shown as median [Q1 - Q3]. Purple colour for Daylight Saving Time (DST) and yellow for Standard Time (ST); Δ LAST: difference between Local And Sun Time.

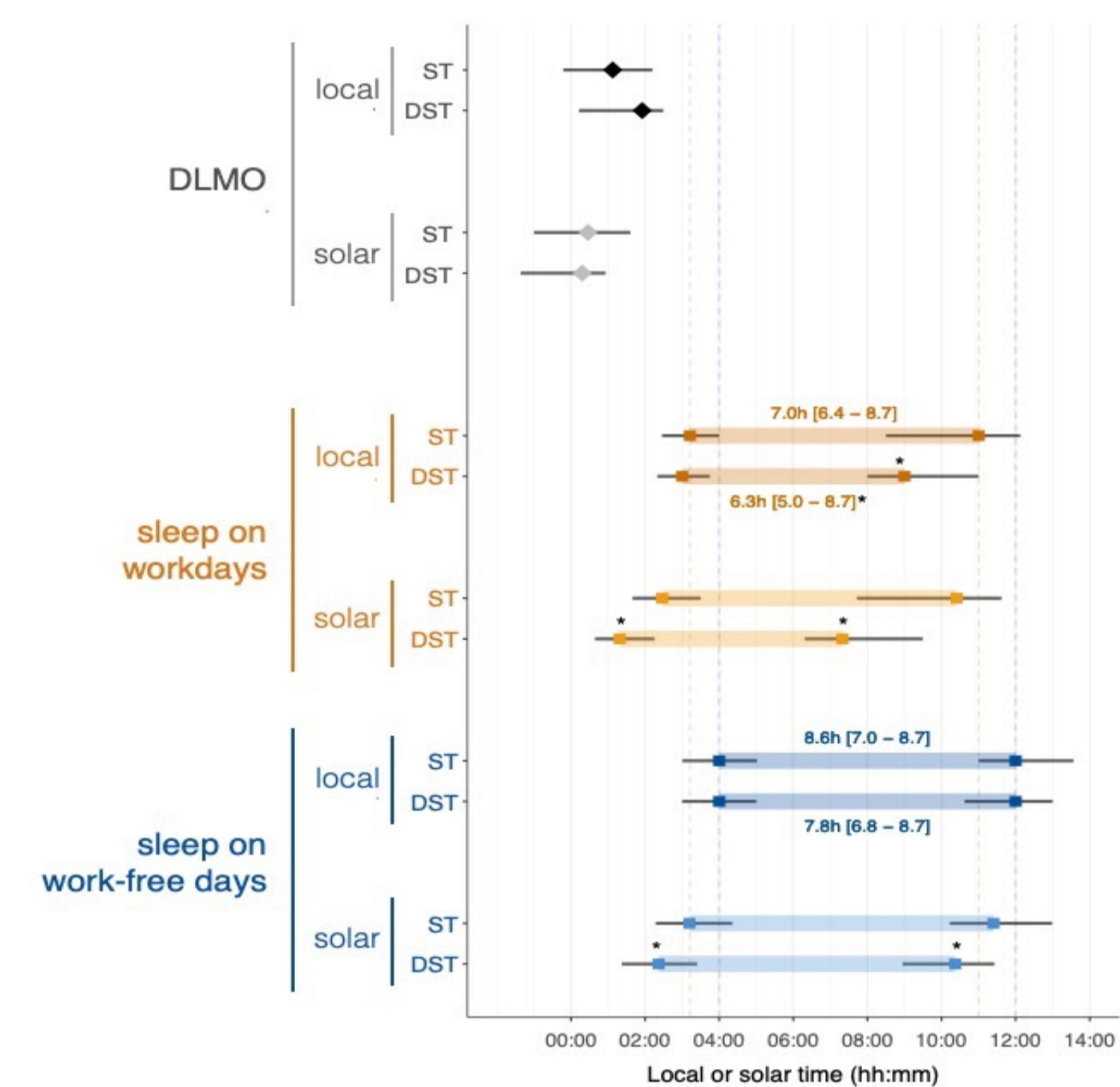


Figure 1. Sleep timing and duration on workdays and work-free days according to date of data collection (daylight saving time [DST] vs. standard time [ST]). Dim Light Melatonin Onset (DLMO) was collected once on a weekday and group medians in different contexts are represented as diamonds; whiskers represent Q1-Q3. Median sleep onsets and offsets are represented as squares; whiskers represent Q1-Q3. Sleep duration values are shown on the top/bottom of local-time bars as median [Q1 - Q3]; please note that durations are shown only along with local time because they cannot be different in sun time. *p < .05 as compared to ST, Wilcoxon-Mann-Whitney test (ST vs. DST).

Table 2. Association of local time, work and their interaction with sleep duration, sleep timings (sleep onset and sleep end)

Dependent variable	Local time (DST vs. ST)	Work (workdays vs. work-free days)	Local time*Work
Sleep duration (SD)	-0.74 (0.37)*	-0.83 (0.26)**	-0.49 (0.34)
Sleep onset (SO)	0.02 (0.35)	-0.74 (0.18)***	-0.08 (0.23)
Sleep end (SE)	-0.06 (0.04)	-0.14 (0.03)***	-0.07 (0.04)

Generalized equation models results adjusted for age and sex; *p < .05, **p < .01, ***p < .001. Coefficients (standard errors) are shown. Please note that the distribution and link function of the dependent variable are: normal-identity in the case of SD and SO, gamma-log in the case of SE.

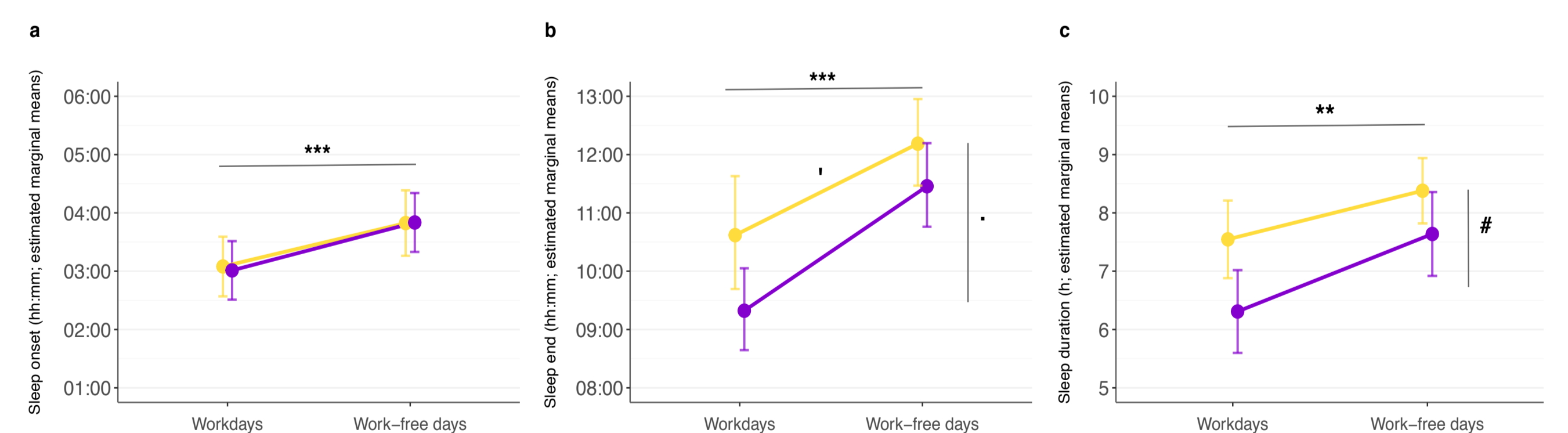


Figure 3. Estimated marginal means from GEE models having as dependent variable: (a) sleep onset, (b) sleep end, (c) sleep duration. Asterisks indicate a significant effect of work (workdays vs. work-free days); * p < 0.05, ** p < 0.01, *** p < 0.001. Sharp indicates a significant effect of local time (DST vs. ST; # p < 0.05, . p = 0.10). We could not falsify our hypothesis of an interaction of DST*work (p = 0.09).

DISCUSSION/CONCLUSIONS

- On a weekly average, patients slept an hour less in DST (62 min. p<0.01), mainly due to sleep on workdays (SD_w, p<0.01), which also correlated with Δ LAST (rsp = 0.35, p<0.01). Patients whose data were collected during DST exhibited shorter sleep duration on both work- and work-free days, but tended to sleep shorter on workdays, demonstrating the significant higher social pressure these patients face.
- While the time from DLMO to SO was similar in ST and DST, the time from DLMO to SE was significantly shorter. The average duration between DLMO and sleep end was close to 10.5h, the biological night length described in the literature⁴.
- Our results favour perennial ST and suggest assigning time-zones close to sun time to prevent social jetlag and sleep deprivation.
- We suggest it to be particularly important for DSWPD patients. Such a decision could even reduce DSWPD incidence, a sleep disorder with major implications for individuals and society

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