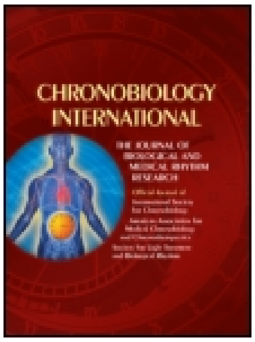

Chronobiology International

The Journal of Biological and Medical Rhythm Research

ISSN: 0742-0528 (Print) 1525-6073 (Online) Journal homepage: https://www.tandfonline.com/loi/icbi20

Sleep patterns and sleepiness among young students: A longitudinal study before and after admission as trainees and apprentices

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Chronobiology International, 2015; 32(4): 478–485
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ISSN: 0742-0528 print / 1525-6073 online
DOI: 10.3109/07420528.2014.993765

ORIGINAL ARTICLE

Sleep patterns and sleepiness among young students: A longitudinal study before and after admission as trainees and apprentices

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In developing countries, youngsters start to work during the high school years. Several studies have shown the difficulties associated with double shift, i.e. to work and study concomitantly, and its negative health consequences. Work and study time, as social synchronizers, have significant effects on the sleep-wake cycle (SWC). The purpose of this study was to evaluate sleep patterns and sleepiness in young students before and after entering the workforce as apprentices or trainees. Participants were 40 adolescents (26 males), 15–18 years old (mean = 15.8 years old) engaged in a first-job program at a non-governmental organization (NGO) while attending evening high school in the outskirts of the city of São Paulo, Brazil. The participants wore actigraphs (Ambulatory Monitoring, Inc.) and registered subjective sleepiness on KSS (Karolinska Sleepiness Scale) along 7 consecutive days, before and after admission to the job. Descriptive analyses were performed, and the variables were tested by means of the *t*-test and repeated measures ANOVA taking factors day of the week and time of the day into consideration. The participants' sleep duration on weekdays exhibited significant difference before and after starting work ($F = 4.55$; $p = 0.04$); the mean sleep duration was 492 min (SD = 44 min) before admission to the job to decrease to 405 min (SD = 58 min) after starting work. The mid-sleep time exhibited significant difference on weekdays before and after starting work (04:57 h; SD = 45 min versus 03:30 h; SD = 54 min; $F = 4.91$; $p = 0.03$). Finally, also sleepiness on weekdays ($F = 6.41$; $p = 0.04$) and at the waking time ($F = 10.75$; $p < 0.01$) exhibited significant difference before and after admission to the job. This article emphasizes the fact that social synchronizers like working during the day and studying in the evening changed the participants' SWC and were associated with sleep restriction. Brazilian governmental incentives notwithstanding, simultaneous performance of several activities by young workers should be considered as an occupational health hazard. Employment policies targeting young workers should take the dual shift – study and work – and its effects on the sleep-wake cycle into account.

Keywords: Adolescents, high school students, restriction of sleep duration, sleepiness, sleep-wake cycle

INTRODUCTION

There are about 108 million young people aged 15–24 years old in Latin America and the Caribbean, out of whom 37.2 million study only, 35.3 millions work only and 13.3 millions work and study concomitantly (ILO, 2010). In Brazil, about 18 million young adults are included in the labor market (Fundação IBGE, 2012). In the attempt to reduce youth unemployment, the Brazilian government formulated laws and incentive programs to encourage adolescents to enter the labor market, to wit, the so-called ''first-job programs''. In addition, it gives tax incentives to companies that hire young people (Brasil, 2000).

Starting at age 14 years old, young people are allowed to work as apprentices and trainees. Thus, they may acquire professional experience and training while attending school likely in the evening hours (Luz et al, 2012). The number of youths who enter the labor force to improve their financial conditions has increased in recent years. This is a common scenario in developing countries (ILO, 2010). However, the effects of simultaneous work and study on the young workers' health are a cause of concern, which motivated quite a few studies.

Submitted July 10, 2014, Returned for revision November 25, 2014, Accepted November 27, 2014

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Recent reports point to the negative effects of full time jobs (6–8 h daily) combined with evening school on adolescents (Fischer et al., 2003a,b; Luz et al., 2012; Pereira et al., 2011). Among several negative outcomes, partial restriction of sleep duration and excessive daytime sleepiness were found (Teixeira et al., 2004a,b, 2007).

The expression of the sleep–wake cycle (SWC) is influenced by biological and social factors (Louzada & Menna Barreto, 2003). In adolescents, a phase delay was observed in the biological rhythms (Andrade et al., 1993; Carskadon et al., 1993), whereby they usually sleep and wake up later compared to children (Epstein et al., 1998). Little is known about the changes in the SWC when youngsters enter the job market (Carskadon, 1990; Fischer et al., 2008; Pereira et al., 2011; Teixeira et al., 2007). Changes in the SWC may compromise attendance and/or the academic performance of adolescents who work during the day and study in the evening, in addition to be associated with health problems and work-related injuries (Luz et al., 2012).

There are no longitudinal studies reporting changes in the adolescents' routine/SWC after starting work. Considering this scenario and the fact that study and employment exert significant impact on the life and activities of high school students, subtle changes in SWC are worth to be investigated. The aim of this study was to evaluate sleep patterns and sleepiness in young students before and after entering the workforce as apprentices or trainees.

METHODS

Sample size

The sample size was calculated based on the mean (± standard deviation) sleep duration of working and non-working students assessed in a previous study by Teixeira et al. (2007), which was 7 h 12 min (SD = 23 min) and 8 h 29 min (SD = 27 min), respectively. Considering $\alpha = 5\%$, $\beta = 10\%$ and $T = 1.0$, the minimum sample size was estimated as 40 students to attain power enough to detect changes in SWC before and after the students started work (Hulley & Cummings, 1988).

Ethical issues

This study was approved by the research ethics committee of School of Public Health, University of São Paulo, no. 2097. The study complied with the ethical guidelines in the Declaration of Helsinki, World Medical Association (Portaluppi et al., 2010). The participants and their parents signed consent forms before the onset of data collection.

Inclusion/exclusion criteria

Potential participants in this study ($n = 130$) were students who attended a training course provided by a non-governmental organizational (NGO) at a low-income neighborhood in the outskirts of the city of São Paulo, Brazil (latitude 23° 32′ 51″ South and longitude 46° 38′ 10″ West). This NGO has prepared high school students and helped them enter the job market over more than 25 years. The training course was taught either in the morning (08:00–12:00 h) or the afternoon (12:30–17:00 h). The students were allocated to the morning or the afternoon course as a function of the distance between their homes and the training center. Thus, the ones living farther from the training center were allocated to the morning course, so they had time to return home before attending high school or technical/undergraduate college in the evening (19:00–23:00 h).

The investigators met the students ($n = 130$) at the NGO premises to invite them to participate in the study. The ones who agreed were subjected to a comprehensive questionnaire addressing health problems, sleep duration, sleep disorders and use of medication that could interfere with their daily sleep routine.

The students who attended the morning course reported sleep restriction due to late bedtimes and early rising from Monday to Friday. According to the students' reports, the mean bedtime was 00:02 h and the mean wake up time 05:54 h. The sleep duration reported by the students who attended the afternoon course was longer: the mean bedtime was 00:31 h and the mean wake up time 09:00 h. Therefore, to evaluate the impact of work on sleep and sleepiness, we invited 40 students who had not reported prior sleep restriction to continue to participate in the study; all of them were the ones attending the training course in the afternoon. The participants were also requested to report their daily caffeine intake before and after starting work.

After attending the NGO preparatory course for 6 months, all the participants were hired by companies as apprentices or trainees, most of them to work as administrative assistants. Their usual work schedule was from 8:00 to 16:00, Monday through Friday. The trainees continued to attend the NGO course once per month, and the apprentices once per week. All the participants continued to attend evening high school after job admission.

Data collection

Data collection was performed before and after the participants started at the job. The data corresponding to the period before the participants started work were collected from March to June 2011 (autumn) and from August to mid-October 2011 (end of winter and spring). The data corresponding to participants already working were collected from August to mid-October 2011 (end of winter and spring) and from March to June 2012 (autumn and early winter). The second data collection was performed after an interval of 3 months at least. Data collection was not performed along the summer daylight saving time (DST; mid-October to end of February) or during the winter vacation (July). We waited 4 weeks after the DST was over to restart data collection. The difference between the maximum and minimum photophase values in São Paulo was about 01:48 along the period of data collection (List, 1951).

Life, health and work characteristics

The participants ($N = 40$) answered a comprehensive questionnaire to assess sociodemographic conditions, lifestyle, health conditions, including use of medication, symptoms/sleep disorders, excessive sleepiness (Pires et al., 2007) and difficulty to concentrate at school (never, seldom, sometimes, often/almost every day). After starting at the job ($N = 40$), the participants also responded a questionnaire addressing their working conditions.

Actigraphy parameters

Participants wore actigraphs (Ambulatory Monitoring, Inc., Ardsley, NY) along 7 consecutive days, before and after they started work. The actigraph records were automatically processed by software AW2, version 2.6 (Ambulatory Monitoring, Inc., Ardsley, NY) and the Sadeh algorithm was used to estimate information on sleep onset and offset, sleep duration and mid-sleep time (Sadeh & Acebo, 2002). The participants also filled out sleep diaries. The actigraphy and sleep diary records were compared to detect discrepancies to improve the precision of the sleep parameters recorded by actigraphy. Flaws in the actigraph records were detected relative to four participants in one of the two periods of data collection. Nevertheless, actigraph records for three full weekdays and two weekend days were obtained, which allowed including the data corresponding to those four participants for analysis (Acebo et al., 1999).

Naps were excluded from analysis, as they represented less than 5% of the sleep time as reported. Sleep bouts that took place from Sunday evening (bedtime) to Friday morning were considered as occurring in workdays, and the ones recorded from Friday evening to Sunday morning as occurring in the weekend.

Sleepiness perception

The participants reported self-perceived sleepiness on the Karolinska Sleepiness Scale (Akerstedt & Gillberg, 1990) eight times per day: at the time they woke up, 7:00, 11:00, 13:00, 16:00, 19:00, 22:00 h and immediately before bedtime. Workday records were Monday to Friday, and weekend records were Saturday and Sunday.

Statistical analysis

Descriptive analyses were conducted. SWC parameters were compared before and after the participants started at the job by means of repeated measures ANOVA. The *post hoc* Bonferroni test was also performed. The significance level was set at 5%, and the data were analyzed using SPSS for Windows, version 20.0 (IBM Corporation, Armonk, NY).

RESULTS

Characteristics of the studied population

Participants were 40 students (26 males), aged 14–18 years old, mean = 15.8, SD = 0.89. All of them were single and had no children. The mean body mass index (BMI) was 21.4 kg/m^2 (SD = 3.78 kg/m^2), being higher than 25 kg/m^2 in five cases (range: 28–33 kg/m^2). On weekdays (Monday–Friday), the participants spent an average of 87 min in public transportation; after they started work, the time spent in this activity increased to 125 min. About 75% of the male participants reported to play soccer on weekends, while the female ones did not report regular practice of any physical activity. All the participants were non-smokers. About 55% of the participants reported consumption of alcoholic beverages, but less than once per week. Most participants (90%) reported difficulty to concentrate at school and to feel sleepy and tired in the evening.

Before starting at the job ($n = 38$), the average caffeine intake was 86.32 mg (SD = 85.6 mg) on weekdays, and 118.42 mg (SD = 99.8 mg) on weekends. After starting at the job ($n = 19$), the average caffeine intake was 111.89 mg (SD = 101.6 mg) on weekdays and 124.25 mg (SD = 188.8 mg) on weekends ($F = 2.32$; $p = 0.13$).

The salary was approximately US$300.00 per month. Most students attended high school (80%), while the remainder of the sample attended technical or undergraduate courses. Most participants were hired as office assistants, being that most of the tasks posed intellectual, rather than physical demands.

Characteristics of the sleep–wake cycle

No significant difference ($p > 0.05$) was observed in the sleep onset before and after the participants started work or between workdays and weekends. On weekdays, the sleep onset time was, on average, 00:42 h (SD = 41 min). After starting the job, the sleep onset time was 00:01 h (SD = 75 min). On weekends, the participants fell asleep, on average, at 01:13 h (SD = 87 min), and after starting work at 00:54 h (SD = 70 min).

From Monday to Friday, the students woke up, on average, at 09:00 h (SD = 56 min). After starting work, they woke up significantly earlier, on average, at 06:48 h (SD = 57 min). Comparing all weekdays, we observed significant differences in the sleep offset ($F = 2.40$; $p < 0.03$), as well as between conditions before and after starting in the job ($F = 3.68$; $p < 0.01$).

On weekends, before they started work, the participants woke up, on average, at 09:00 h (SD = 54 min) and after they started at the job, at 09:35 h (SD = 50 min). Significant difference was not found in the sleep onset on weekends between both conditions.

From Monday to Friday, the students slept about 08:12 h (SD = 44 min) and after they started work, the sleep duration decreased to 06:45 h (SD = 58 min); that difference was significant ($F = 4.55$; $p = 0.04$). On weekends, the participants slept 08:41 h (SD = 47 min) and

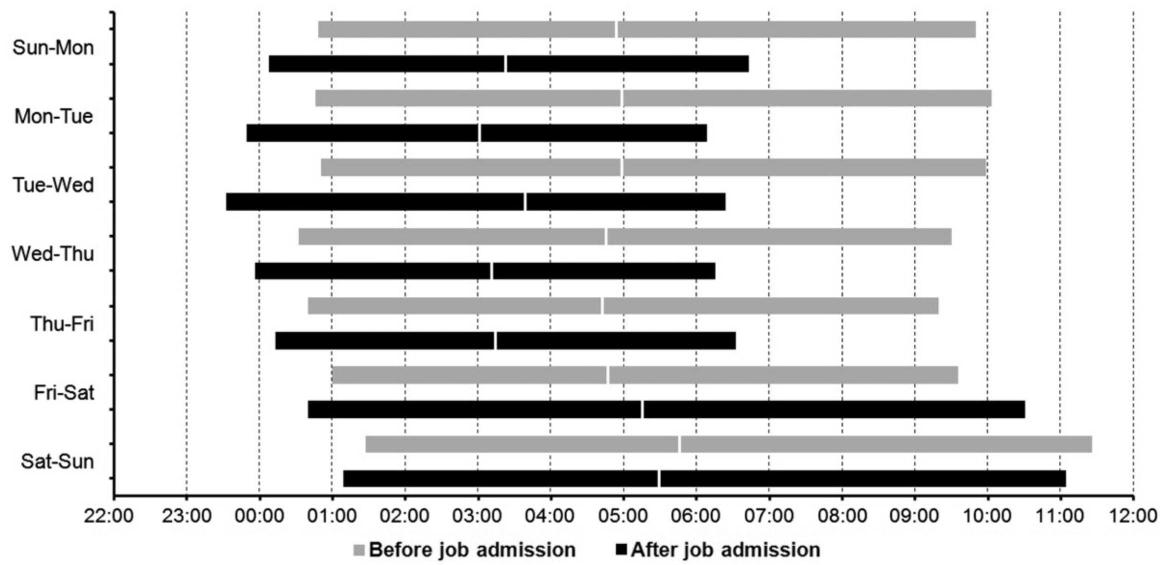

FIGURE 1. Means of sleep onset, offset, duration and mid-sleep time per day of the week, before and after starting work.

after starting at the job, 08:59 h (SD = 51 min); that difference was not significant ($p > 0.05$).

On weekdays, the participants' mid-sleep time was 04:57 h (SD = 45 min) and after they started work, 03:30 h (SD = 54 min); that difference was significant ($F = 4.91$; $p = 0.03$). On weekends, significant difference was not found in the mid-sleep time before (04:42 h; SD = 72 min) and after (05:12 h; SD = 63 min) starting at the job (Figure 1).

Sleepiness perception

Figure 2 depicts the results corresponding to self-perceived sleepiness before and after the participants started work. The sleepiness perception was higher at the beginning and the end of each day (U shape).

On weekdays, there was significant difference in the reported sleepiness before and after the participants started at the job ($F = 6.41$; $p = 0.04$). Sleepiness was higher at the waking time after starting work ($F = 10.75$; $p < 0.01$; Figure 2), except for Wednesday. After starting at the job, the sleep onset was earlier (mean = 23:56 h SD = 56 min) on the night from Tuesday to Wednesday, compared to the remainder of the week; however that difference was not statistically significant ($p > 0.05$; Figure 1).

Regarding the differences in sleepiness per weekday, greater sleepiness at the waking time was found on Monday, Tuesday, Thursday and Friday. Sleepiness at bedtime was greater on those same days, except for Friday ($F = 10.75$; $p < 0.01$; Table 1).

On the weekends (Saturday and Sunday), i.e. when the participants did not work, the differences in reported sleepiness before and after admission to the job were small, however, the difference corresponding to the waking time was significant ($F = 9.91$; $p < 0.01$; Table 2).

DISCUSSION

We found changes in the SWC patterns of students after they started at the job. On weekdays (Monday–Friday), there was a significant sleep reduction due to earlier wake times. Regarding sleepiness, the working students reported higher levels on workdays compared to the former condition before starting work.

A social synchronizer such as the working time has an important effect on SWC and makes the sleep time more similar among subjects (Harrison & Horne, 1995). After admission to the job, students had to follow a stricter daily routine, which extended the length of their waking time, while students before job admission could follow their biological preferences. Significantly shorter sleep periods were found among the working students on all school days (about 2 h/day) compared to the former situation. According to Bat-Pitault & Da Fonseca (2012), reduction of 2–4 h/day in the nocturnal sleep duration is associated with reduction in the level of daytime alertness, which is cumulative.

A former study on sleep in adolescents conducted by Valdez et al. (1996) showed that on weekdays, the ones attending school in the afternoon slept longer, on average (8:35 h), than the ones who attended school in the morning (6:40 h). Contrariwise, Louzada & Menna Barreto (2003) did not find significant differences in the sleep duration upon comparing 13 year olds attending school in the morning or in the afternoon. However, neither of those studies included working students.

Regarding the sleeping times, the students showed no significant changes in the sleep onset before and after admission to the job. This was probably due to the fact that at both data collection periods, i.e. before and after starting work, the participants attended school in the evening (Teixeira et al., 2004a, 2010).

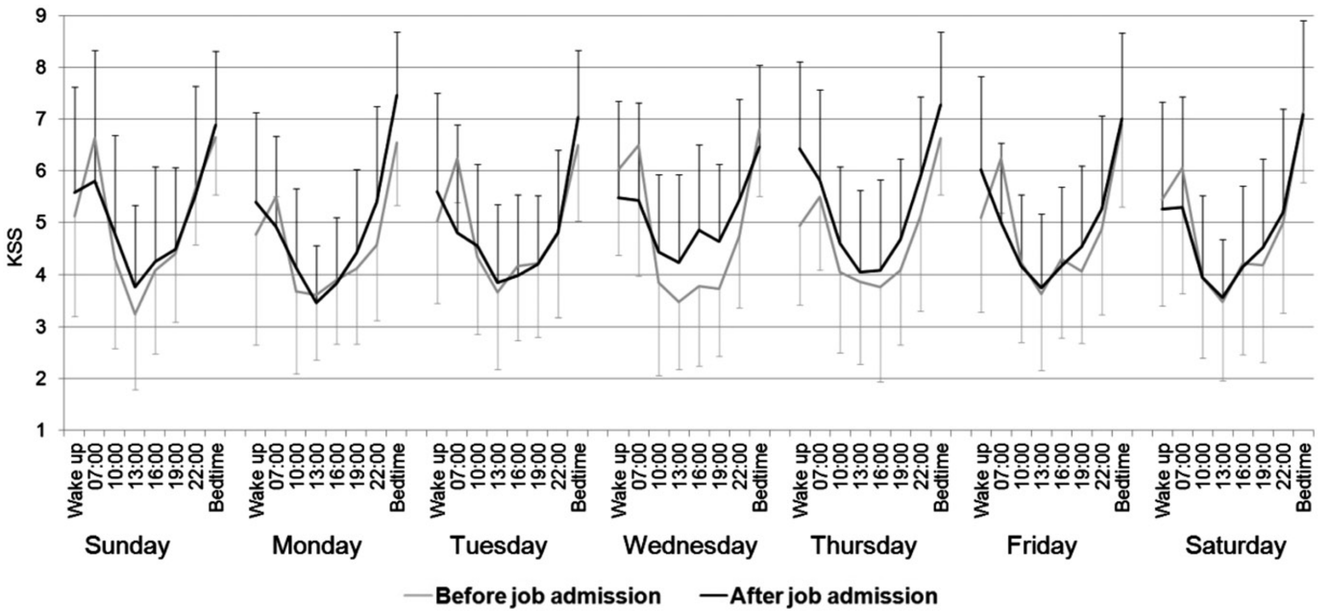

FIGURE 2. Mean and standard deviation of reported levels of sleepiness (KSS) by students before and after admission to the job on weekdays and weekend.

TABLE 1. Sleepiness levels (mean and SD values) before and after admission to the job on workdays.

	Before job admission		After job admission	
Reported sleepiness during waking times	Mean	SD	Mean	SD
Wake up time[a]	5.19	1.64	5.70	1.05
Morning (10:00–12:59 h)	4.15	1.76	4.44	0.99
Afternoon (13:00–19:00 h)	3.60	0.86	4.09	0.90
Evening (at 22:00 h)	5.14	1.15	5.16	1.12
Bedtime	6.92	1.07	7.08	1.01

[a]$F = 10.75$; $p < 0.01$ Repeated ANOVA.

TABLE 2. Sleepiness levels (mean and SD values) before and after admission to the job on the weekend.

	Before job admission		After job admission	
Reported sleepiness during waking times	Mean	SD	Mean	SD
Wake up time[a]	5.15	1.64	5.57	1.52
Morning (10:00–12:59 h)	4.29	1.31	4.35	1.20
Afternoon (13:00–19:00 h)	4.01	1.26	4.12	1.07
Evening (at 22:00 h)	6.61	0.94	5.44	1.46
Bedtime	6.92	1.07	6.96	1.26

[a]$F = 9.91$; $p < 0.01$ Repeated ANOVA.

However, after starting work, the participants woke up much earlier (on average, at 06:48 h) on workdays (Monday–Friday) compared to the former condition (on average, at 09:00 h), resulting in restriction of the duration of sleep (on average, 6 h 45 min). It should be stressed that in a large city like São Paulo, commuting time is relevant and consumes several hours every day. In this study, the working students reported they spent, on average, 125 min every day commuting compared to their former condition (87 min). That longer commuting time was an additional reason to wake up earlier, in addition to the fixed time to arrive at work in the morning. Earlier studies conducted with working high school students from São Paulo reported similar results (Luz et al., 2012; Teixeira et al., 2004b).

In addition, a phase advance of the mid-sleep time was detected among the working students. Our results agree with the ones of previous studies that found reduction of the sleep duration in working students (Carskadon, 1990; Fischer et al., 2008; Pereira et al., 2011; Teixeira et al., 2004b; Vinha et al., 2002).

Among the working students, the sleep duration was longer on the weekend (on average, 539 min) compared to weekdays (on average, 405 min), thus indicating a sleep rebound on Saturday and Sunday. As pointed out by Roenneberg et al. (2012), school and work-life are associated with reduced sleep duration during the workweek and over-sleeping on weekends, as sleep is profoundly influenced by work schedules. However, in this study, significant difference was not found in the sleep duration upon comparing the two conditions (before and after work). This is likely to be associated with social activities performed on Saturday and Sunday.

In recent times, the increase of social and school activities among young people led to a reduction of the time available to sleep (Dahl & Carskadon, 1995; Kalenkoski & Pabilonia, 2012). Touitou (2013) observed that along adolescence, reduction of the sleep duration leads to sleepiness, fatigue, anxiety and poor academic performance.

It is worth to notice that admission to the job might not be considered to be the only reason for sleep reduction and greater sleepiness among working students. While investigating potential participants for this study, we found that students attending school in the morning reported sleep restriction. Overuse of the Internet is associated with excessive daytime sleepiness, as observed by Choi et al. (2009) among South Korean high school students. However, data on Internet use were not available in this study.

After starting work, the participants reported greater sleepiness, which was particularly evident at the waking and bedtimes on workdays. The decrease in the sleep duration, the early awakening aggravated by a phase delay in bedtime resulted in a U-shaped pattern. Previous studies reported similar results relative to sleepiness among teens at work (Carskadon, 1990; Teixeira et al., 2007).

Data in the literature indicate that sleepiness showed an additional afternoon peak in several days, a so-called ''post-lunch dip'', perhaps associated with the expected small decline of body temperature in early afternoon (Carskadon & Dement, 1979). In this study, before being admitted to the job, the participants attended a training course that started at 13:00 h. After starting work, the participants had lunch with their colleagues. We believe that the performance of group activities at that time accounts better for the lower sleepiness level at 13:00 h, and the increase of sleepiness close to the end of the workday. The phase delay of sleep observed in adolescents is explained by the changes in their physiology and psychosocial environment (Carskadon et al., 1993; Moore & Meltzer, 2008). This phenomenon has significant effects on working students, resulting in dissociation between the biological and social components of sleep (Carskadon, 2011).

The working students in this study were adolescents and probably still had a phase delay in their waking and sleeping times. In addition, the earlier wake up times to go to work disagreed with their biological needs. That fact, thus, might have been associated with greater sleepiness and negative consequences by reducing their sleep time.

In a study conducted by Teixeira et al. (2004a) in Brazil, the working students reported poorer sleep quality following sleep restriction compared to colleagues who were not in the labor force. Those authors found increase of sleepiness among the working students, especially on Mondays, which was associated with changes in the sleep time on weekends. In addition to sleepiness complaints, the working students missed classes more often than the non-working ones (Teixeira et al., 2004b).

Similar symptoms were observed among working students from Rhode Island (USA). Those students slept later than the non-working ones, and their sleep time depended on the time spent at work and the amount of extracurricular activities. As a consequence of the reduction in the sleep duration, the working students showed excessive sleepiness and symptoms related to daytime sleepiness, such as difficulty to keep awake while driving a vehicle, to pay attention in class and to do homework (Wolfson & Carskadon, 1998). The working students in our study reported that they did homework after midnight, after coming back home from evening school. The inability to devote sufficient time to studies outside the regular school schedule, higher absenteeism and higher drop-out rates compared to non-workers are additional negative outcomes observed among young workers attending evening school (Fischer et al., 2003b).

To reduce and/or avoid excessive sleepiness, caffeine, tobacco or other drugs are used as alerting strategies (Millman, 2005), as well as performing physical activities (Kelman, 1999). The study conducted by Lodato et al. (2013) found significant caffeine intake among Portuguese adolescents. The caffeine intake reported by the participants in our study was higher compared to the Portuguese adolescents.

Increased waking hours might also be responsible for the occurrence of work injuries, associated with poor working conditions (Fischer et al., 2003a). Reduced attention and concentration in class, decrease in performance and in the time available to accomplish school tasks and perform physical activities, and the perception of chronic tiredness impair the adolescents' intellectual development and reduce their rest time (Carskadon, 1991; Fischer et al., 2005; Giannotti & Cortesi, 2002; Kalenkoski & Pabilonia, 2012; Nagai et al., 2007; Santana et al., 2005; Teixeira et al., 2006, 2007).

Carskadon (2011) and Laberge et al. (2011) call the attention to the fact that the impact of the changes, such as depression, sleepiness and fatigue, in the health of working students ought to be properly understood by society, as it directly or indirectly promotes increasing involvement of youths in social activities, like early entry in the labor market, for considering them to be positive for their social development.

Public policies targeting working adolescents ought to take their chronobiological needs into consideration, including sleep, as well as their individual preferences in the planning of health, work and educational actions for youths.

Although entering the job market in adolescence, while still attending school might be positive in some regards, this study showed that performing simultaneous activities induces significant changes in the students' sleep patterns, which might possibly impair their state of health and wellbeing.

Limitations of the study

This study had some limitations that derive from its design and the sample characteristics, which demand caution in the interpretation of the results and their extrapolation to other settings and populations. The data were collected at a NGO educational center. Thus being, the sociodemographic characteristics of the studied population might not be representative of other training centers. In addition, response bias due to the possible influence of earlier participants on their colleagues cannot be ruled out.

Although the present was a longitudinal study, the data were collected along one week only, and some participants' behaviors might have not been the routine ones.

The participants might have not reported sleep disturbances not addressed by the questionnaire or detected by the actigraph and/or comorbidities like respiratory problems, which might affect sleep and cause diurnal sleepiness.

The largest difference in the photophase, 01:48 h, between the periods of data collection might have interfered with the SWC. However, as the wake time depended on the strict school and work schedules, we believe that the aforementioned variation in the photophase did not play a preponderant role in the results.

Only 19 participants reported to consume caffeine after starting work. Such small number might have increased the standard deviation, resulting in lack of statistical difference in the caffeine intake before and after admission to the job.

The above-mentioned limitations notwithstanding, this study exhibits remarkable strengths and addresses a gap in the literature. Its longitudinal design enabled us to evaluate the SWC of a same population of young students before and after admission to the job, with consequent control of the population variability. It also enabled us to detect very subtle differences associated with the admission to the job.

CONCLUSIONS

High school students admitted into the workforce as apprentices or trainees underwent substantial changes in their sleep/wake cycle on workdays, particularly significant shortening of the sleep duration and greater sleepiness. The daytime sleepiness after admission to the job was moderately elevated in the evening, and thus might have impaired the participants' school performance. Shorter sleep duration and sleepiness might have negative consequences on the quality of life, school performance and intellectual development.

Governmental incentives notwithstanding, simultaneous performance of activities by young workers should be considered as an occupational health hazard. Employment policies targeting young workers should take the dual shift – study and work – and its effects on the sleep/wake cycle into account.

DECLARATION OF INTEREST

The authors declare no conflicts of interest. This study was financially supported by the São Paulo Research Foundation (FAPESP) grant 2011/00029-3, CNPq and all the participants in this study.

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