

Perspective

It is time to abolish the clock change and adopt permanent standard time in the United States: a Sleep Research Society position statement

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Abstract

Daylight saving time (DST) refers to the practice of advancing clock time by 1 h each spring, with a return (setting back) to standard time (ST) each fall. Numerous sleep and circadian societies other than the Sleep Research Society have published statements in support of permanent ST, and permanent ST has also received support from multiple medical societies and organizations. This perspective discusses the positive and negative health and economic consequences of permanent DST, permanent ST, and maintaining the status quo (DST for part of the year). After a thorough review of the existing literature, the SRS advocates the adoption of permanent ST.

Key words: daylight saving time; permanent standard time; sleep loss; circadian misalignment

Statement of Significance

The national debate in United States over Daylight saving time (DST) is a timely issue. In March 2022, the US Senate passed the Sunshine Protection Act to make DST permanent in states that have previously chosen to make that change. However, the US House has not passed this legislation. One of the strongest arguments for adopting permanent standard time (rather than permanent DST) is related to health, sleep, and circadian biology. As reviewed in this perspective, because of the health benefits of permanent standard time, the Sleep Research Society advocates the adoption of permanent standard time.

Introduction

Daylight saving time (DST) refers to the practice of advancing clock time by 1 h each spring, with a return (setting back) to standard time (ST) each fall. States can currently opt out of moving to DST and stay on ST year-round (permanent ST). Adopting DST year-round (permanent DST) requires federal legislation. This is a timely issue, given that in March 2022, the US Senate passed the Sunshine Protection Act to make DST permanent nationwide. States that have previously chosen to stay on ST year-round would be exempt, and other states would have a limited time to pass legislation to stay on ST year-round. However, the US House has not passed this legislation and DST remains an active issue. Eighteen states have enacted legislation or passed resolutions to make DST permanent. Since 2015, at least 350 bills and resolutions supporting either permanent ST or permanent DST have been introduced in almost every state [1].

Numerous sleep and circadian societies other than the Sleep Research Society (SRS) have published statements in support of

permanent ST [2], and permanent ST has also received support from multiple medical societies, national and local parent-teacher associations, and Start School Later [3]. In contrast, the business community, including the National Association of Convenience Stores and the Sporting Goods Manufacturing Association support permanent DST [4].

This perspective discusses the positive and negative consequences of permanent DST, permanent ST, and maintaining the status quo (DST for part of the year). After a thorough review of the existing literature, the SRS advocates the adoption of permanent ST.

What is the History of Clock Changes?

The concept of changing the hours of human activity to “save daylight” has been attributed to Benjamin Franklin, who awakened early one morning in Paris, in 1784, to discover that his room was “filled with light. I imagined at first that a number of lamps

had been brought into the room but rubbing my eyes I perceived the light came in at the windows". Franklin [5], who routinely woke at noon, then proceeded to estimate the savings in evening candle use if Parisians woke at dawn.

In contrast to what Franklin proposed, where a population wakes earlier to make the best use of daylight, DST changes the clock time. DST shifts daylight into the early evening in exchange for less daylight in the early morning when more people are presumed to be asleep. This light exchange has both social and economic benefits, with more natural light for evening activities and less need for artificial light in the evening. However, as will be discussed, there are health consequences to DST for those whose school or jobs require them to awaken early. Many encounter darkness, especially in the winter months and in geographic areas where sunrises are later (e.g., in the more northern and in the western edges of time zones). Evening light extended too close to bedtime can also disrupt sleep patterns [6].

During World War I, initially Germany and then Great Britain implemented summer DST as a wartime measure. The wartime goal of shifting clocks ahead by 1 h was to save energy, by maximizing natural light later in the day and minimizing the need for electric lighting. The United States entered the war in 1917 and adopted DST in 1918, marked by a grassroots campaign focused on Congress that included sports organizations, businesses, and labor unions. DST was observed in the United States from April through October of 1918, and after World War I ended in November 1918, it was not reinstated. The largest opposition to DST came from rural America, specifically farmers, whose schedules were disrupted by DST [5]. With World War II, the United States again adopted DST, this time year-round. The war effort was the rationale for adopting DST, which was presumed to minimize the need for electricity, thereby saving energy costs.

After World War II ended, state governments were responsible for start and end dates of DST. Inconsistencies in schedules led to challenges with railroad scheduling and affected safety, resulting in Congress passing the Uniform Time Act in 1966. DST was observed from the last Sunday in April until the last Sunday in October. During the energy crisis of 1973–1974, Congress adopted DST year-round for 2 years, but this policy was abolished early due to public opinion, specifically related to traffic accidents (including fatalities) in children going to school in the dark on winter mornings [7, 8].

In 2007, the Uniform Time Act was amended to expand DST from the second Sunday in March to the first Sunday in November. States and territories are allowed to opt out of observing DST, and Arizona and Hawaii are on permanent ST, along with Puerto Rico, the U.S. Virgin Islands, Northern Mariana Islands, Guam and American Samoa.

Acute DST Transitions—Consequences for Health and Well-Being

As reviewed above, DST came about to "save daylight" and provide extended light in the late afternoon and evening in the spring, summer, and early fall, which many Americans appreciate for partaking in outdoor activities. The rationale for reverting back to ST in the fall and winter was to avoid dark mornings.

However, recent public opinion polls have shown strong support for ending the clock change. In a survey of a nationally representative sample of 1500 US adult citizens, 63% of adult US citizens were in favor of abolishing the clock change, 21% were not sure, and 16% were opposed to abolishing the clock change [9]. Nearly twice as many Americans preferred DST to ST. Older

adult citizens (age 65+) were more supportive of ending the clock change than their younger counterparts. In a separate poll, 75% of the US adults wished to end the clock change, with 43% preferring permanent ST and 32% preferring permanent DST [10]; this poll also showed that older adults preferred to end the clock change compared to younger adults. Sleep loss and a decline in well-being are two factors that have been identified as affected by the clock change.

Sleep loss

Time-use data studies (which capture how individuals spend their time) have documented that individuals sleep, on average, 15–20 fewer minutes per night in the week after the spring transition to DST [11]. High school students showed reduced weeknight sleep duration (average of 30 min) by actigraphy, with a decline in psychomotor vigilance testing (slower response times) and increased daytime sleepiness [12]. Their average sleep duration was reduced from 7 h, 51 min pre-DST transition weeknights to 7 h, 19 min post-DST weeknights.

Well-being

Self-report of the spring transition to DST on life satisfaction scores has also been negatively associated with well-being, especially for men and those with full-time employment. A lower quality of sleep was reported up to 2 weeks after the spring transition, with easier adjustments to the fall transition back to ST. An American Academy of Sleep Medicine survey of more than 2000 adults in the US found that more than half of Americans (55%) typically feel tired after the spring transition to DST [13].

Health consequences have also been associated with the clock change, especially the spring transition to DST.

Stroke

Hospitalizations for stroke were significantly increased during the first 2 days after both the spring and fall transitions, with a relative risk of 1.08 (95% confidence interval of 1.01–1.15) [14]. Women, older adults, and those with cancer had increased susceptibility. Compared to the fall transition, the spring transition to DST had a 24% increased risk for in-hospital mortality.

Myocardial infarction

A meta-analysis of more than 115 000 patients documented a higher risk of acute myocardial infarction during the spring transition to DST [15]. Atrial fibrillation was also found to increase in the four days after the spring DST transition [16].

The pathophysiology of increased cardiovascular and cerebrovascular disease is uncertain. Apart from sleep loss, another important possible cause is circadian misalignment (e.g., mismatch in timing between our biological clocks and our social environment, also referred to as social jetlag) [17]. Circadian misalignment may alter gene expression, increase production of inflammatory markers, and lower vagal tone resulting in higher heart rate and blood pressure [2]. It should be noted that the clock change resulting in circadian misalignment is different than traveling across time zones (e.g., from Central Time in Nashville to Eastern Time in New York), in which natural light in our environment changes, along with the clock change, allowing for a smoother biological transition.

Traffic accidents

Findings have been mixed for traffic accidents related to DST [18]. However, in the largest study to date, of more than 700 000

motor vehicle accidents, the risk of fatal traffic accidents was found to be modestly increased during the spring DST transition, especially in the morning and in locations further west in a time zone [19].

Given these effects on health and well-being, an argument can be made for elimination of DST. However, elimination of DST means adopting permanent ST or permanent DST.

What are the Arguments for Adopting Permanent ST?

At first glance, it seems that a one-hour clock change in March would not have long term deleterious effects on health. However, as noted above, this clock change is occurring for almost eight months (until November) resulting in chronic circadian misalignment. The timing of natural light becomes desynchronized from normal physiological processes, with dysregulation of melatonin and cortisol. Disruption of these hormones contributes to stress, altered metabolism, and inflammation [6]. Advocates for permanent ST argue that adopting permanent DST would worsen circadian misalignment even more than at present. This is because we would be dealing with 12 months of circadian misalignment, rather than almost 8 months.

The literature on time zone border effects [6] has been used to support the role of DST in contributing to sleep loss and circadian misalignment. Compared to those living on the eastern edge of a time zone, people living on the western edge of a time zone, who get light later in the morning, and later in the evening, self-report getting less sleep based on time-use data, derived by the U.S. Bureau of Labor Statistics [20]. This sleep loss is believed to be secondary to evening light exposure delaying the brain's release of melatonin. Sleep loss in adults has been associated with weight gain and obesity, diabetes, hypertension, heart disease, and stroke, depression, and increased risk of death, along with impaired immune function, increased pain, impaired performance, increased errors, and greater risk of accidents [4]. Sleep loss in children has been associated with attention, behavior, and learning problems along with increased risk of accidents, injuries, hypertension, obesity, diabetes, depression, self-harm, suicidal thoughts, and suicide attempts [21].

Furthermore, the residents living in the western edges had higher rates of obesity, diabetes, heart disease and breast cancer, along with lower per capita income and higher health care costs [6]. Many other cancers, including chronic lymphocytic leukemia (in men and women), cancers of the stomach, liver, prostate, and non-Hodgkin lymphoma in men and cancers of the esophagus, colorectum, lung, breast, and uterus in women have shown increased risk from east to west within a time zone [22].

Those supporting a return to permanent ST argue that permanent DST would exacerbate these effects, with those living in the western edge even more prone to misalignment [17]. Adolescents represent another vulnerable population. Because puberty causes melatonin to be released later at night and lowers the pressure to sleep, combined with societal factors such as screen time and social networking, academic demands and early school start times [23], adolescents are particularly susceptible to sleep problems from the extended evening light of DST. Early school start times also make adolescents prone to waking up in the dark, especially in the winter months if permanent DST was adopted. In fact, permanent DST may negate any beneficial effects of delaying school start times [24]. Adults with less control over their schedules, who need to drive to work in early morning

hours and cannot adjust their wake time to awaken after sunrise, are also more at risk for misalignment.

What are the Arguments for Permanent DST?

The strongest health arguments for adopting permanent DST are related to having extended light in the late afternoon/early evening for outdoor activities, including physical exercise, which promotes both sleep and well-being. This point is particularly relevant to adults who work full-time (or children who are in school until the late afternoon) who want to engage in physical activity outside after work/school. Individuals with lower incomes who have less control over their work schedules, cannot afford gym memberships, and wish to exercise outdoors in the light due to concerns about safety after dark may also benefit from the extended light of permanent DST. In an observational study of physical activity in more than 23 000 children from nine countries, measured by accelerometers, longer evening daylight was associated with a small increase in daily physical activity. The magnitude of these associations was largest in the late afternoon and early evening, and just after the clocks changed [25]. In an observational study of adults conducted in Western Australia prior to and after the introduction of DST, individuals shifted their exercise from the morning to the evening during DST [26]. However, there was also an overall reduction in the average number of daily exercise sessions during DST, with 8% not exercising at all during DST. This may have resulted from the late afternoon heat being restrictive to exercise.

Extending light later in the day may also have a beneficial effect on the economy resulting from dining out, shopping, and other activities that increase consumer spending. JPMorgan Chase and Company [27] analyzed consumer spending using an anonymized sample from over 2.5 million customers, making over 380 million credit and debit card transactions. Los Angeles, a city that observes DST, and Phoenix, a city that does not observe DST, were compared. Relative to Phoenix, in Los Angeles, daily card spending increased by 0.9% on weekdays and 1.1% on weekends at the start of DST and dropped by 4.1% on weekdays (when after-work darkness may decrease purchases) and 2.1% on weekends at the end of DST. Grocery stores, fuel, discount stores, and other retail stores were the most affected by the end of DST. Robberies also decreased modestly (7%) following the shift to DST [28].

Splitting the Difference?

A final option to consider is splitting the difference and adopting a clock change 30 min between ST and DST, which may mitigate the negative health consequences of transitioning back and forth between ST and DST. The downside of this option for advocates of permanent DST would be less extended light in the late afternoon and evening for outdoor activities and shopping compared to a full hour of DST. For advocates of permanent ST, mornings would still be darker earlier (and evenings lighter later) compared to if permanent ST was in effect, with 30 min of circadian misalignment year-round. From a logistical perspective, the United States would be "off sync" with many major countries globally, including our European economic trading partners. It should be noted, however, that there is great variability in when different countries make the switch from ST to DST [29], and therefore a 30-min difference may be considered less disruptive, especially if other nations follow suit and eliminate the transition to and from DST.

Recommendation

Determining the best policy in the DST debate is complex, especially given variability in geography (e.g., increased susceptibility on the western edge of time zones), work schedules (e.g., needing to be at work in the early morning), and vulnerable populations (e.g., adolescents). However, from a health standpoint, the bulk of evidence supports abolishing our current spring transition to DST and adopting permanent ST, given the risk for sleep loss and circadian misalignment, and their accompanying adverse health consequences. As such, the SRS strongly supports the adoption of permanent ST. Education and advocacy focused on both state legislatures and the US Congress will be critical to the adoption of permanent ST.

Disclosure Statement

Financial Disclosure: None.

Non-financial Disclosure: None.

Conflict of Interest Statement: The author has no conflict of interest.

Data Availability Statement

No new data were generated or analyzed in support of this research.

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