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Short- and long-term effects of seasonal daylight saving time and Polish students' attitude towards it

SZYMON LEONIK[A–F], MICHAŁ SMOCZOK[A, B, D]
ORCID ID: 0000-0002-0904-6545

Prof. Zbigniew Religa Students Scientific Association, Department of Biophysics, Medical University of Silesia, Zabrze, Poland

A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary **Background.** Despite a long period of observing the consequences of annual time changes, the opinion about their impact on health is not univocal. The correctness of the decision made in March 2019 by the European Parliament concerning abolishing daylight saving time, taking into account scientific literature, remains indecisive.

Objectives. The aim of the study is to determine the impact and subjective opinion of daylight saving time (DST) on the population of people between 18 and 32 years of age in Poland.

Material and methods. The survey was conducted among students of Polish universities. 696 people took part in the survey. In order to compare qualitative variables, the Pearson's Chi-squared test was used, and quantitative variables were compared with the student's *t*-test for two groups or by analysis of variance (ANOVA) for more than two groups. As a Post Hoc test, Turkey's test for unequal *n* was applied. Values of $p < 0.05$ were considered significant. The analysis was performed using Statistica software.

Results. Females made up 85.1% of the study. As a result of experiencing negative symptoms, 2.9% needed medical help and 10.5% took medicines. Most of the respondents are convinced about the negative impact of DST on their health. People who expressed a negative opinion about time changes have significantly more complications.

Conclusions. Even a short-term disturbance of chronobiological rhythm homeostasis can have dangerous consequences, such as traffic accidents, cardiovascular system disorders or sleeping disorders. Even if only a small percentage of the society is negatively affected, the abolition of daylight saving time may be beneficial.

Key words: circadian rhythm, Delivery of Health Care, mental health, Poland, students.

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Background

The current law in the European Union obliges Member States to change time twice a year in order to take into account the changing composition of the day. The aim is a more effective use of daylight. Each year, on the last Sunday of March, the clocks are set one hour ahead, and on the last Sunday of October, the clocks are set back to standard time. Due to economic reasons, Member States decided in the past on introducing agreements regarding summer time. In order to save coal, used to produce electricity, they were adopted first by Germany and France during World War One. During the war, they were joined by Great Britain, as well as by other European countries. After the end of both World Wars, many European countries abandoned this practice. A pan-European law on daylight saving time arrangements, the unification of the various applicable practices and timetables, was introduced for the first time in 1980. In this way, a holistic approach to daylight saving time (DST) changes within the single market was provided. In Poland, the division into summer and winter time has been in force, with breaks, since 1919. Interestingly, despite a very long time observing the potential effects of introducing this practice, researchers do not agree on its impact on human organism. The voices of opponents of the continuation of annual time changes resulted in a pan-European debate in 2018, which led the European Parliament in March 2019 to introduce regulations abolishing time changes in EU countries from 2021. The final decision about the abolishment of time changes in EU countries is to remain within the remit of each Member State [1]. An open and, taking into account reports from scientific literature, an indecisive question remains the correctness of a potential abolishment of the existing regulations.

The internal biological clock of living organisms makes the synchronisation of the circadian cycle and organic processes possible. This chronobiological mechanism is extremely important for the metabolic homeostasis of human organisms. Maintaining a correct cycle ensures an adequate course of neurometabolic pathways, cardiovascular mechanisms, hormonal balance and more. Even a temporary loss of homeostasis can disturb one's physical and mental state, contributing to undesirable short-term symptoms, such as headaches, decreased ability to concentrate, general fatigue and absent-mindedness. Symptoms, if they occur, usually last up to one week after changing the time. Even short-term symptoms of disturbance of circadian rhythm homeostasis can potentially have dangerous consequences [2–4]. Individual authors do not agree when it comes to the conclusions of the analysis of data collected over the decades. The presence of additional environmental factors makes drawing clear conclusions more difficult or even impossible. Most authors agree, however, that the period of switching to summer time is tolerated worse by society, and it is this aspect that we will focus on in this study [2, 3, 5, 6].

The researchers observed an increase in the number of traffic accidents within one week of switching from winter to summer time. The peak is reached on Sunday – an increase of up to 16%, and on Monday – an increase of up to 12%. During the following 4 days, a rise in the frequency of traffic accidents of up

to 4% is observed, only to return to the baseline values on Saturday. The explanation of this phenomenon is most likely lack of sleep, rush, concentration disorders and general distraction [5, 7, 8]. A significant correlation between mental and behavioural disorders, chronic sleep disorders and the severity of negative symptoms after changing time has been recorded. These people are in a group of increased likelihood of causing or being a victim of a traffic accident [9]. The effects of switching from winter to summer time in the short term are negative, but in the long term, they are beneficial. From the second week after the discussed period, a decrease in the number of fatalities among pedestrians by 8–36% was recorded, as well as a decrease in the number of fatalities among cyclists by approx. 13% and a decrease in the number of fatal accidents involving motor vehicle drivers by 3–10% [10–15].

Cardiovascular system disorders during the change from winter to summer time are another phenomenon described in literature. Cardiometabolic dysfunctions are a significant clinical problem often occurring in the European population, and the mechanisms related to periodic hypoxia, sympathetic hyperactivity, insulin resistance and damage to pancreatic beta cells can lead to cardiovascular disorders. Moreover, disturbance of the physiological concentration of tumour necrosis factor alpha, an inflammatory factor, is also associated with a higher risk. The mechanisms described above occur or intensify, among others, in connection with a disturbance of the chronobiological rhythm as a result of time changes [2, 3, 5, 6, 16–20]. In the conducted studies, an increase of 3–8% in the number of ischemic strokes was observed, and an increase in the number of acute coronary syndromes by 3–5% was also seen (no differences in the frequency of STEMI and NSTEMI). The described changes disappear after up to 1 week, and the greatest intensity is observed in the first 2 days after changing the time. Furthermore, a correlation between the coexistence of chronic diseases (e.g. diabetes, renal failure, obesity, autoimmune diseases, respiratory diseases) and cardiovascular episodes during the time change period was observed [2, 5, 6, 16, 17].

Another, apparently obvious, implication of switching time seem to be sleeping disorders, both when it comes to quality and quantity. However, newer reports contradict this theory. These disorders, if they occur, last up to 5 days after the time change, but the number of registered cases is not statistically significant [8, 21]. No important change in the length of sleep nor its influence on the intensification of chronic diseases was noted. Moreover, regardless of the polymorphism in the CLOCK and PER3 genes, responsible for the chronotype, no significant changes in sleep dysfunction were observed in the study group [21–23].

Furthermore, an attentive analysis of data will help improve the management of human resources in health care, better work organisation and thus more effective life-saving actions in potentially critical periods [2, 7]. The analysis of literature shows that few studies deal with the topic of DST in terms of the functioning and organisation of health care. Examples of challenges during DST are presented in Table 1 [24].

Table 1. Organisational challenges caused by DST within health care

Increased working hours in night shifts and the impact of DST on staff wages
Need to manually change time on devices that do not have automatic time correction
Distribution of blood products and timing of their administration
Effect on the supply of medicines taken at regular intervals
Potential lack of synchronisation of laboratory equipment with the hospital system and the probability of marking the collected sample as unsuitable for analysis
Possible errors in the time of sampling and obtaining the result (laboratory result before collecting the material)
Need for manual restarting of devices, including those that support patients' life

Objectives

The aim of the present study is to carry out an analysis of Polish students' subjective opinion on the short- and long-term effects of seasonal daylight saving time in the context of their health.

Material and methods

From 15 April to 22 April 2020, students of Polish universities[1] were asked, via a questionnaire, about the observed effects and their opinion on the annual time changes. The results of the survey were presented as a percentage of the group indicating a given answer, visualised in graphs and tables. In order to compare qualitative variables, the Pearson's Chi-squared test was used, and quantitative variables were compared with the student's *t*-Test for two groups or by analysis of variance (ANOVA) for more than two groups. As a Post Hoc test, Turkey's test for unequal *n* was applied. Values of $p < 0.05$ were considered significant. The analysis was performed using Statistica software.

This work does not require the opinion of the Bioethics Committee.

Results

696 people took part in the study – 85.1% females, 14.9% males. The study group was divided into five age groups (Fig. 1).

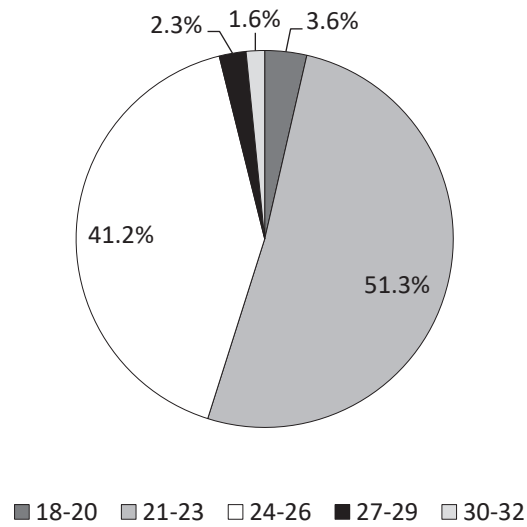

Figure 1. Age structure of the study group

The respondents evaluated DST as – definitely positive 4.5%, positive 12.9%, having no influence 35.8%, negative 37.8%, definitely negative 9.1%. Examples of subjective symptoms observed by the respondents are presented in Table 2.

As a result of experiencing negative symptoms, 2.9% needed medical help, 10.5% took medicines, and 14.3% took dietary supplements. The average number of symptoms were three per person. The number of negative symptoms does not correlate with gender nor age ($p = 0.943$, $p = 0.054$). Symptoms disap-

[1] The University of Rzeszow, The Wroclaw University of Economics, The University of Wroclaw, The Bialystok University of Technology, The University of Gdansk, The Pedagogical University of Cracow, The Medical University of Lublin, The Gdansk University of Technology, The University of Warmia and Mazury, The University of Zielona Gora, The University School of Physical Education in Wroclaw, The University of Economics in Katowice, The Medical University of Silesia.

Table 2. Positive and negative symptoms observed among the respondents up to a week after changing the time from winter to summer time

Positive symptoms		Negative symptoms	
Better concentration	25	Headaches	137
Better sleep	63	Worse general sensation	229
Better physical performance	37	Problems with concentration	187
Better memory	7	Sleeping problems	198
Better general sensation	143	Excessive sleepiness during daytime	226
Alleviation of the course of a chronic disease	6	Dizziness	32
		Fainting	4

peared after 0–1 days in 24.1% of the cases, 2–3 days in 30.1%, 4–5 days in 20.2% and ≥ 6 days in 25.6%. 49.4% of respondents believe that DST has a negative influence on their health, 7.9% think it is positive, while according to 42.7%, it has no influence. 75.9% of people who took part in the survey believed that abolishing time changes is a good idea. No correlation between age and the assessment of the effects of DST on health was observed (Pearson correlation = -0.04863).

In connection with experienced symptoms, some of the respondents took dietary supplements – 17.4% females and 12.5% of males. A correlation between the duration of symptoms and the percentage of people taking dietary supplements was observed (Fig. 2), as well as between the assessment of the impact of DST on health and the percentage of people taking dietary supplements (Fig. 3). The frequency of taking supplements did not significantly depend on gender (p = 0.37994). There was also no correlation when it comes to taking medicines (p = 0.16845).

People who experienced negative effects of DST were seen to have sought medical help more often (Fig. 4).

People who expressed a negative opinion about time changes had significantly more complications than people with a neutral or positive opinion (Fig. 5, 6).

Additionally, we examined association between the amount of symptoms and ones' opinion about the influence of time change on patients (Tab. 3). The analysis shows that people who declared a negative impact had the most adverse effects in total.

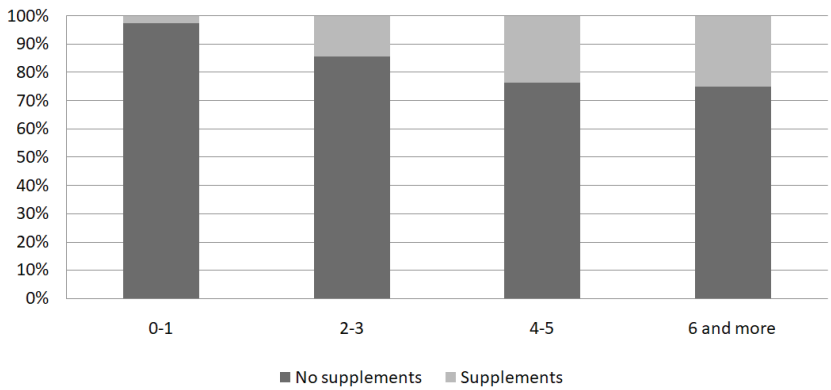

Figure 2. The percentage of respondents taking dietary supplements in relation to the duration of symptoms (p < 0.0001)

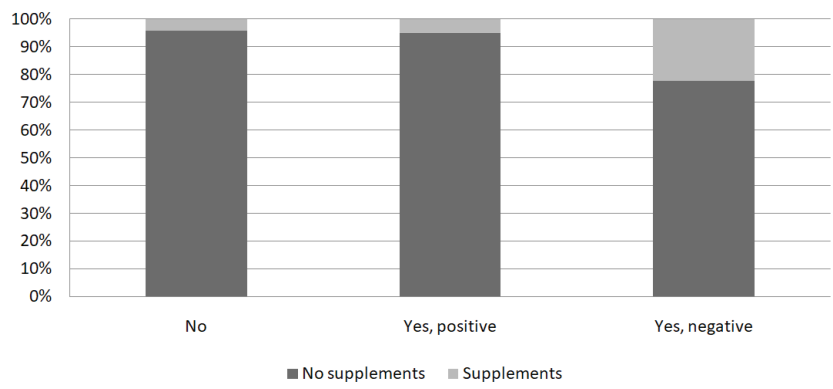

Figure 3. "Does DST have an influence on health?" Survey responses in relation to taking dietary supplements (p < 0.0001)

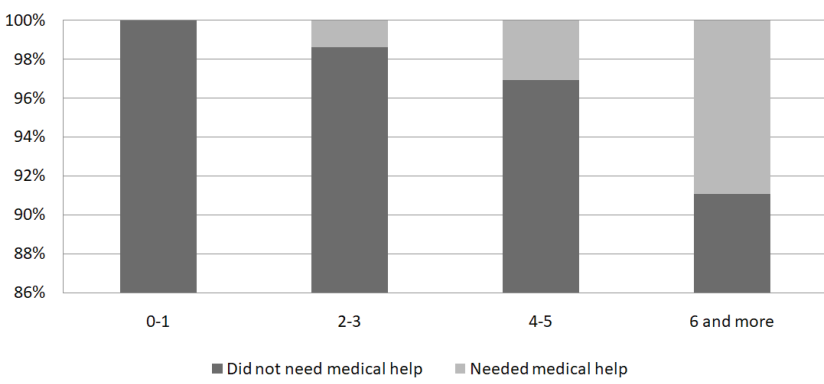

Figure 4. Duration of DST symptoms in relations to seeking medical help (p = 00048)

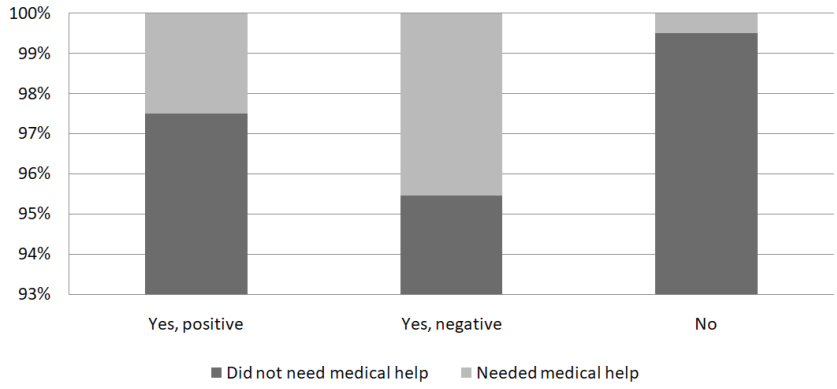

Figure 5. Survey responses in relation to the influence of DST on health and seeking medical attention (p = 0.02978)

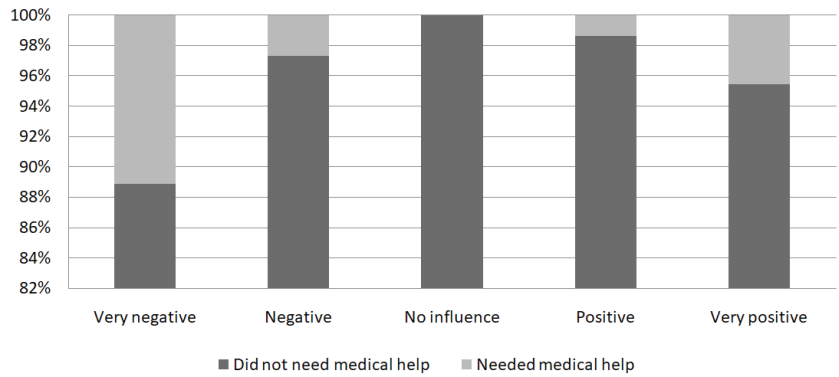

Figure 6. Subjective sense of the influence of the last DST on the respondents in relation to seeking medical help (p = 0.00046)

Table 3. Association between opinion about the influence of time change on amount of symptoms estimated using ANOVA (significant difference between positive and negative perception and between no influence and negative perception, Post Hoc Turkey's test)

	Amount of symptoms			
Do you think daylight saving time has an impact on health? Which one?	*n*	mean	SD	*p*
Positive	17	1.7	1.047	< 0.001
Negative	293	3.7	2.134	
No influence	105	2.0	1.351	

Discussion and conclusions

It is worth highlighting that each of the analyses presented above requires further observation and verification as there are sources that present different conclusions, i.e. no correlation between time changes and the increase in the number of traffic accidents, cardiovascular incidents or the effect of time changes on sleep disorders [7–10, 18]. Such varying conclusions may be related to statistically significant differences between social groups, e.g. an unrepresentative study group, no division of observations into individual days of the week, traditions, holidays, the way of spending free time, preferred way of locomotion or proper behavioural adaptation of society in a critical period, manifested by postponing duties to a later date, or an attempt to adapt to change through going to sleep earlier.

In the study, most of the respondents are convinced about the negative impact of DST on their health. Table 2, with the symptoms that the respondents observed, shows it. These symptoms had a direct impact on their quality of life in the period directly after DST. None of the respondents suffered any significant trauma within 1 week of DST, but the perceived symptoms certainly increased the probability of negative events, like traffic accidents [11–15]. As in the analysed literature, most of the negative symptoms in the gathered group decreased within 1 week – a quarter of the respondents experienced symptoms related to DST longer than 7 days. Taking into account the decreasing severity of negative symptoms with time, and the inborn regulation of the chronobiological cycle after DST, we agree with the statement that the long-term effect of DST is insignificant [2–6, 19, 21]. However, a different conclusion must be drawn from the short-term impact on the health of the study group and, extrapolating our results, of the society. Manifested symptoms like headaches, concentration problems, dizziness and sleeping issues increased the probability of the accidents, sick leave, medications and excessive supplementation within 1 week from DST. Due to the relatively young study group, incidents like myocardial infarction, ischemic strokes and heart arrhythmias were not observed, but such occurrences must be taken into account, especial in an aging society as in Poland [2, 3, 16, 17, 20]. Even if a slight percentage of society is negatively affected by DST and is injured or is in a situation directly threating life, it is worth raising this phenomenon for further discussion. Consequently, abolition of the change of time and staying on summer time may be beneficial for most of society. As far as the study carried out is concerned, it should be mentioned that the questionnaire completed by the respondents was not ben validated. Further prospective research to explain the observed phenomena must be carried out in order to draw decisive conclusions.

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Conflicts of interest: The authors declare no conflicts of interest.

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Address for correspondence:
Szymon Leonik, MD
Fundacja Rozwoju Kardiochirurgii
ul. Jagodowa 2/9
41-800 Zabrze
Poland
Tel.: +48 510 854-713
E-mail: leonikszymon@gmail.com