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# Perceived Sleep Quality among Intensive Care Unit Patients: A Cross-Sectional Study



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## Abstract

**Introduction:** Sleep plays a crucial role in the recovery of patients in the intensive care unit (ICU), yet it is frequently disrupted by specific environmental and clinical factors. Sleep quality influences the cognitive, emotional, and physical health of patients and is recognized as an important component of the treatment process. The aim of this study was to examine how hospitalized ICU patients perceive their sleep quality and to identify the main environmental factors that influence it.

**Methods:** A cross-sectional quantitative study was conducted in the ICU of the Clinical Hospital Center Osijek between February and April 2025. The study included 95 hospitalized patients. Data were collected using a questionnaire developed specifically for this research, based on available literature. Statistical analysis included both descriptive and inferential methods.

**Results:** The strongest negative associations with sleep quality were observed for the infusion pump alarm sound (ρ = 0.753) and pain (β = 0.274; *P*=0.003). Diagnostic procedures (β = 0.326; *P*= 0.002) and blood sampling (β = 0.241; *P*=0.02) demonstrated weaker but still statistically significant negative associations. No significant differences in sleep quality were observed between sexes (*P*=0.86), whereas the presence of malignant disease was associated with poorer sleep quality (*P*=0.04).

**Conclusion:** Sleep among ICU patients is markedly impaired, particularly due to noise, pain, and frequent nighttime interventions. Additional efforts are needed to optimize the ICU environment, educate healthcare staff, and individualize care to improve sleep quality in intensive care settings.

# INTRODUCTION

Sleep is a fundamental biological need that plays a crucial role in maintaining physical, psychological, and emotional health. During sleep, numerous vital processes occur, including tissue regeneration, hormonal regulation, memory consolidation, and emotional stabilization. In the context of hospital care, particularly in intensive care units (ICUs), patients' sleep quality is often impaired due to a combination of environmental, organizational, and clinical factors [1-4]. Studies indicate that more than 70 percent of ICU patients report sleep disturbances such as frequent awakenings, reduced REM sleep, and a persistent feeling of fatigue [2].

Sleep disruption in the ICU arises from multiple causes, including noise from medical equipment alarms, intense lighting, pain, invasive medical procedures, and the use of analgesics and sedatives [3-6]. Numerous studies confirm that poor sleep quality not only delays recovery but also increases the risk of complications such as delirium, metabolic disorders, and immune dysfunction [7-10]. Inadequate sleep also negatively affects patients' perception of healthcare quality and prolongs hospital stay [11-14]. Delirium, increasingly linked to sleep deprivation, further worsens clinical outcomes and increases mortality [15, 16].

Despite growing evidence highlighting the importance of sleep, its protection in hospital settings has not been systematically integrated into clinical practice. Guidelines such as the ABCDEF bundle in critical care (2017) include sleep as a key component of patient care, yet their practical implementation remains limited [17]. The 2018 update of the Society of Critical Care Medicine's Clinical Practice Guidelines for the Prevention and Management of Pain, Agitation/Sedation, Delirium, Immobility, and Sleep Disruption in Adult ICU Patients (PADIS) expanded recommendations to include immobility and sleep disruption, recognizing them as modifiable risk factors associated with adverse ICU outcomes [18]. The most recent PADIS Working Group update (2025) further introduced recommendations for the pharmacological management of agitation, sedation, and sleep in critically ill adult patients [19].

Additional challenges in sleep assessment stem from objective monitoring methods such as polysomnography, which are often impractical in ICU settings. For this reason, subjective tools such as the modified Freedman Sleep Quality Questionnaire (mFSQQ) are increasingly used in daily practice, allowing patients to directly evaluate their sleep quality and identify specific disturbances [2, 20, 21].

The literature reveals a relative scarcity of studies that simultaneously analyze patients' subjective sleep experiences and the impact of specific environmental factors in the ICU. Furthermore, there is still no consensus on which factors have the most pronounced negative influence or how these can be effectively mitigated [8, 22].

This study contributes to the existing body of knowledge through a detailed analysis of ICU patients' perceived sleep quality, with a particular focus on environmental influences. Special attention is given to the effects of noise, lighting, and nocturnal medical interventions, as well as their relationship with patients' subjective perception of sleep. The aim of this study was to assess the quality of sleep among patients hospitalized in the intensive care unit and to identify the main environmental factors contributing to its impairment.

# METHODS

## Study design

This study employed a cross-sectional quantitative design to examine the quality of sleep among hospitalized patients in an intensive care unit (ICU) and to determine the influence of environmental factors on sleep.

## Setting and samples

The research was conducted in the Intensive Care Unit of the University Hospital Centre Osijek between February and April 2025. The study included 95 hospitalized patients. Eligible participants were conscious adult patients aged 18 years or older, of both sexes, who were able to provide informed consent. A convenience sampling method was used to recruit participants.

### Measurements and instruments

Data were collected using a structured questionnaire developed specifically for this study, based on the validated Freedman Sleep Questionnaire, which has been widely used in similar research [1]. The questionnaire was adapted to the target population, taking into account the specific sociocultural characteristics of the hospital environment in the Republic of Croatia. It included items related to sociodemographic characteristics (age, sex), clinical data (diagnosis, presence of comorbidities, and length of ICU stay), and a subjective assessment of sleep quality.

Sleep quality, sleep duration, frequency of nocturnal awakenings, and level of daytime sleepiness were assessed using a 10-point Likert type numerical scale, where higher scores indicated better sleep quality or lower levels of sleepiness. In addition, participants rated the perceived impact of environmental factors (noise, lighting, medical interventions, and medical equipment) on sleep quality using a 10-point Likert type scale, where higher scores indicated a greater perceived negative impact.

### Data collection/procedure

Data collection was conducted through patient interviews after at least one night of ICU stay, when patients' level of consciousness and ability to communicate were stable. Participation was voluntary and anonymous. All participants were informed about the purpose of the study and provided written informed consent before inclusion.

### Ethical considerations

The study was approved by the Ethics and Professional Committee of Nurses and Medical Technicians for Health Care of the University Hospital Centre Osijek (approval number: R1-96-5/2025). It was conducted in accordance with all applicable ethical standards, including the principles of Good Clinical Practice, the Declaration of Helsinki, the Health Care Act of the Republic of Croatia, and the Act on the Protection of Patients' Rights. No identifying data were collected, ensuring participant anonymity.

## Statistical data analysis

Data were analyzed using JASP software, version 0.19.3 (Department of Psychological Methods, University of Amsterdam, Amsterdam, The Netherlands). Descriptive statistics included measures of central tendency and dispersion, namely the median and interquartile range. Normality of distribution was assessed using the Shapiro–Wilk test, which indicated significant deviation ($P<0.05$); therefore, nonparametric methods were applied. The Mann–Whitney U test was used to compare two groups, while the Kruskal–Wallis test with post hoc Dunn test and Bonferroni correction was applied for comparisons involving more than two groups. Relationships between variables were examined using Spearman correlation coefficients, and predictors of sleep quality were analyzed using linear regression analysis. The level of statistical significance was set at $P<0.05$.

## RESULTS

The study included 95 participants treated in the intensive care unit (ICU), the majority of whom were male (59; 62.1%). The median age of participants was 67 years (interquartile range [IQR] 57–74 years), and the median length of hospitalization was 4 days (IQR 3–5 days). The median sleep quality score was 26 (IQR 21–30), where lower scores indicate greater sleepiness (Table 1).

**Table 1.** Sociodemographic and hospitalization-related variables and descriptive statistics of the subscales of the questionnaire assessing sleep quality among ICU patients

| Variable | | N (%) |
|---|---|---|
| **Gender** | | |
| | Male | 59 (62.1) |
| | Female | 36 (37.9) |
| **Admission diagnosis** | | |
| | Cerebrovascular accident (stroke) | 17 (17.9) |
| | Myasthenic crisis | 1 (1.1) |
| | Myocardial infarction | 45 (47.4) |
| | Pulmonary embolism | 7 (7.4) |
| | Other | 34 (31.4) |
| **Comorbidities** | | |
| | Hypertension | 74 (80.4) |
| | Diabetes | 25 (27.2) |
| | COPD | 2 (2.2) |
| | Malignancy | 3 (3.3) |
| | Cardiovascular | 54 (58.7) |
| | | **Me (IQR)** |
| **Age** | | 67 (57 – 74) |
| **Glasgow Coma Scale (GCS) score at admission** | | 15 (15 – 15) |
| **Glasgow Coma Scale (GCS) score at discharge** | | 15 (15 – 15) |
| **Length of stay in ICU** | | 4 (3 – 5) |
| **Questionnaire for assessing sleep quality among ICU patients – subscales** | | |
| | Sleep quality | 26 (21 – 30) |
| | Daytime sleepiness | 19 (16 – 23) |
| | Sleep disruption due to environmental factors | 88 (73 – 100) |

Note: N – number of participants; % – percentage; Me – median; IQR – interquartile range.

Correlation analysis showed that sleep quality was strongly positively correlated with daytime sleepiness (ρ = 0.500; *P*<0.001) and moderately negatively correlated with sleep disruption (ρ = −0.379; *P*<0.001), indicating that lower sleep quality was associated with greater daytime sleepiness. In addition, sleep disruption was moderately positively correlated with daytime sleepiness (ρ = 0.402; *P*<0.001), suggesting that greater sleep disruption was accompanied by greater daytime sleepiness (Table 2). A significant weak negative correlation was found between participants' age and sleep quality (ρ = −0.207; *P*=0.04), indicating that older participants had better sleep quality (Table 2).

No statistically significant differences in sleep quality, daytime sleepiness, or sleep disruption were found between male and female participants. Analysis by admission diagnosis revealed a statistically significant difference in sleep quality (Kruskal–Wallis test; *P*=0.002). Participants admitted with a cerebrovascular accident had significantly better sleep quality compared with those admitted for other diagnoses (Dunn–Bonferroni post hoc test; *P*<0.05). Regarding the presence of malignancy as a comorbidity, a statistically significant difference in sleep quality was also found (Mann–Whitney test; *P*=0.04), with participants without malignancy demonstrating significantly better sleep quality than those with malignancy (Table 3).

**Table 2.** Correlations between sleep quality, daytime sleepiness and sleep disruption, and correlations of these variables with age, Glasgow Coma Scale scores and length of ICU stay

| | | Daytime sleepiness | Sleep disruption | Age | GCS (admission) | GCS (discharge) | Length of stay in ICU |
|---|---|---|---|---|---|---|---|
| **Sleep quality** | ρ* | 0.500 | -0.379 | -0.207 | -0.114 | 0.028 | 0.138 |
| | P | <0.001 | <0.001 | 0.04 | 0.27 | 0.78 | 0.18 |
| **Daytime sleepiness** | ρ* | | -0.402 | -0.156 | -0.030 | 0.015 | 0.025 |
| | *P* | | <0.001 | 0.13 | 0.77 | 0.88 | 0.81 |
| **Sleep disruption** | ρ* | | - | 0.142 | -0.002 | -0.039 | 0.085 |
| | *P* | | - | 0.16 | 0.98 | 0.70 | 0.41 |

Note: *P* – statistical significance; ρ – Spearman's correlation coefficient; * Spearman correlations.

**Table 3.** Sleep quality, daytime sleepiness and sleep disruption by sex, admission diagnosis and comorbidities

| | Sleep quality | | Daytime sleepiness | | Sleep disruption | |
|---|---|---|---|---|---|---|
| | **Me (IQR)** | ***P**** | **Me (IQR)** | ***P**** | **Me (IQR)** | ***P**** |
| **Sex** | | | | | | |
| Male | 27 (20 – 29) | 0.86 | 20 (16 – 23) | 0.25 | 87 (71 – 98) | 0.10 |
| Female | 26 (21 – 30.75) | | 19 (15 – 22) | | 93(73.75 – 106.25) | |
| **Admission diagnosis** | | ***P**** | | ***P**** | | ***P**** |
| Cerebrovascular accident | 20 (16 – 23) | 0.002 | 21 (17.75 – 27) | 0.09 | 79 (73 – 93) | 0.17 |
| Myocardial infarction | 19 (15 – 22) | | 18 (16 – 21) | | 90 (75 – 102) | |
| Pulmonary embolism | 87 (71 – 98) | | 16 (15 – 18) | | 94 (77.5 – 102.5) | |
| Other | 93 (73.75 – 106.25) | | 20 (14.5 – 24) | | 91(70.75 – 101.5) | |
| **Comorbidities** | | ***P**** | | ***P**** | | ***P**** |
| Hypertension | Yes 26.5 (20 – 29.75) | 0.75 | 19 (16 – 23) | 0.93 | 89.5 (73.25 - 99.75) | 0.37 |
| | No 25 (22 – 29) | | 19 (16 – 23) | | 86 (67 – 99) | |
| Diabetes | Yes 24 (19 - 28) | 0.23 | 19 (16 – 21) | 0.58 | 93 (82 – 102) | 0.16 |
| | No 27 (22 – 29.75) | | 19 (16 – 23) | | 87.5 (20.25 – 98.75) | |
| COPD | Yes 23 (18.5 – 27.5) | 0.84 | 17 (16.5 – 17.5) | 0.46 | 95 (91.5 – 98.5) | 0.50 |
| | No 26 (21 – 29) | | 19 (16 – 23) | | 88 (73 – 99) | |
| Malignancy | Yes 17 (16.5 – 19.5) | 0.04 | 14 (13.5 – 19.5) | 0.27 | 82 (72.5 – 92.5) | 0.77 |
| | No 26.5 (21 – 30) | | 19 (16 – 23) | | 88 (73 – 99.25) | |
| Cardiovascular diseases | Yes 24.5 (20 – 29) | 0.22 | 19 (16 – 23) | 0.81 | 94 (71.5 – 102) | 0.24 |
| | No 27 (23 – 31) | | 19.5 (16 - 22.25) | | 87 (74 – 93) | |

Note: Me – median; IQR – interquartile range; *P* – statistical significance; * Mann–Whitney test; ** Kruskal–Wallis test.

Sleep disruption was strongly and positively correlated with interruptions caused by vital signs monitors (ρ = 0.629; *P*<0.001), pulse oximeter probes (ρ = 0.590; *P*<0.001), intravenous pump alarms (ρ = 0.753; *P*<0.001), and the measurement of vital parameters (ρ = 0.700; *P*<0.001) (Table 4).

**Table 4.** Association of sleep disruption with auditory and visual signals from medical equipment

| | | Vital signs monitor | Finger pulse oximeter probe | IV pump alarms | Measurement of vital signs |
|---|---|---|---|---|---|
| **Sleep disruption** | ρ* | 0.629 | 0.590 | 0.753 | 0.700 |
| | *P* | <0.001 | <0.001 | <0.001 | <0.001 |

Note: P – statistical significance; ρ – Spearman's correlation coefficient; * Spearman correlations.

Linear regression analysis, with ICU activities as predictor variables, showed that the model explained 36.5% of the variance in sleep quality (*P*<0.001; adjusted $R^2$ = 0.365). Statistically significant predictors were pain (*P*=0.003), diagnostic tests (*P*=0.002), and blood sampling (*P*=0.02). Pain had a negative effect on sleep quality, whereas diagnostic tests and blood sampling contributed positively to the sleep quality of patients treated in the ICU (Table 5).

**Table 5.** Regression results – sleep quality as the dependent variable

| | β | t | *P* | $R^2$ |
|---|---|---|---|---|
| **(Constant)** | | 11.449 | <0.001 | 0.365 |
| Pain | -0.274 | -3.068 | 0.003 | |
| Vital signs monitor | -0.228 | -1.981 | 0.05 | |
| Noise | 0.185 | 1.328 | 0.18 | |
| Ventilator alarm | -0.120 | -0.751 | 0.45 | |
| Light | 0.202 | 1.757 | 0.08 | |
| Finger pulse oximeter probe | 0.054 | 0.415 | 0.67 | |
| Nursing interventions | -0.082 | -0.631 | 0.53 | |
| Conversations | -0.265 | -1.907 | 0.06 | |
| Diagnostic tests | 0.326 | 3.123 | 0.002 | |
| IV pump alarms | -0.157 | -1.145 | 0.25 | |
| Measurement of vital signs | -0.160 | -1.338 | 0.18 | |
| Blood sampling | 0.241 | 2.229 | 0.02 | |
| Medication administration | 0.038 | 0.308 | 0.75 | |
| Phones and mobile devices in the room | -0.236 | -1.778 | 0.07 | |

Note: β — regression coefficient; t — t statistic; *P* — statistical significance; Adjusted $R^2$ — coefficient of determination (adjusted $R^2$ = 0.365).

## DISCUSSION

The results of this study indicate that the intensive care unit (ICU) environment significantly reduces patients' subjective perception of sleep quality and that sleep among ICU patients is markedly impaired, particularly due to noise, pain, and frequent nocturnal interventions. Sleep quality in the ICU represents a major challenge, as disrupted sleep patterns are associated with cognitive impairment, delayed recovery, and increased mortality [23]. Effective pain management not only improves physiological stability but also contributes to better sleep, which is essential for recovery, reducing delirium, and restoring immune and cognitive functions [15]. Pain emerged as the most significant negative predictor of sleep quality in this study, consistent with previous results [23, 24]. Pain is reported by 38–51% of patients at risk of dying and is considered one of the most distressing symptoms [25]. Pain control in the ICU plays a crucial role in improving patient outcomes, as untreated or undertreated pain may lead to increased anxiety, delirium, prolonged hospitalization, and a higher risk of chronic pain [23, 24]. According to the PADIS guidelines, a combination of pharmacological and non-pharmacological strategies, individually tailored to each patient, should be implemented [18, 19].

Noise in the ICU is a major environmental factor that negatively affects sleep quality. The World Health Organization recommends that hospital noise levels should not exceed 35–40 dB [2, 26, 27], whereas in ICUs they often reach 53–86 dB [28, 29]. In the present study, most participants reported perceiving noise as excessive and identified it as one of the main causes of sleep disturbance. Measures such as reducing the volume of monitor and telephone alarms and using vibration modes can help lower noise levels and improve rest conditions. Regarding staff communication, patients in this study reported acoustic alarms and auditory signals from medical devices as more disturbing than staff conversations, which partially differs from earlier studies emphasizing loud staff communication as the main source of noise [22]. In a qualitative study conducted in Turkey during the COVID-19 pandemic, equipment sounds and healthcare workers' voices were identified as key factors disturbing patients' sleep, explained by increased workload and the presence of many inexperienced nurses [30]. Loud communication can generate more

noise than alarms or phones; healthcare professionals should therefore be more aware of communication-related noise within the team [31]. The observed results may be explained by the fact that nurses working in intensive care units generally possess extensive professional experience and adhere to clinical guidelines, including adjusting communication volume according to the time of day and night. According to the literature, single-bed rooms can help reduce noise and improve sleep quality [32], but they also have certain drawbacks. For patients, they may increase anxiety due to reduced accessibility to staff [2], while for healthcare workers they may introduce additional stressors such as increased walking distance, reduced patient visibility, and weaker team communication [33].

Inappropriate lighting intensity in the ICU can disturb circadian rhythms and contribute to shorter total sleep duration [24, 34, 35]. To prevent these effects, it is recommended that natural light or artificial lighting be provided during the day, while all unnecessary light sources be turned off and curtains closed at night, preferably by 10 p.m. [36]. The majority of participants reported that lighting levels did not pose a major problem, which may be attributed to nurses' experience in adjusting light intensity according to the time of day and clinical interventions, thereby minimizing patients' exposure to inappropriate illumination.

Stressors such as feelings of loneliness and fear of death negatively affect sleep in ICU patients [37]. Physical contact and communication with patients help them express anxiety and discomfort and ask questions. Moreover, the sense of safety provided by the presence of nursing staff and clinical procedures may contribute to better sleep quality [22, 37]. Blood sampling and diagnostic procedures in this study had a positive effect on sleep perception. Previous studies also report that sleep interruptions due to blood sampling had a smaller impact when a "sleep-promoting" schedule was established, suggesting that the timing and context of these procedures can influence their effect on sleep [38].

The correlations between daytime sleepiness and sleep quality demonstrate a strong association between these variables: poorer sleep quality was associated with greater daytime sleepiness. In the study by Bihari et al., average daytime sleepiness during ICU stay was high, indicating chronic sleep deprivation [22].

In this study, no statistically significant differences in sleep quality were found between sexes, differing from Bihari et al., who observed that sleep quality improved with age in women but not in men. They attributed this to differences in sleep architecture, with older women exhibiting a higher proportion of deep sleep [22]. Studies examining ICU populations have reported a higher incidence of subjective sleep problems among women [39]. However, results remain inconsistent: some studies show that certain objective sleep parameters, such as apnea occurrence or sleep architecture measured by polysomnography, are more prevalent or severe in men, or that differences depend on age and comorbidities [40].

Malignancy emerged as the comorbidity most strongly associated with poorer sleep quality in this study, underscoring the need for individualized approaches to oncology patients. A study conducted in Nepal found that 56% of patients with advanced malignancy experienced significant sleep disturbances [41]. Other comorbidities did not significantly affect sleep quality, consistent with previous research showing that shorter total sleep duration is associated with a higher number of comorbidities, including heart failure and chronic respiratory diseases. Although malignancy was not identified as the dominant comorbidity, the overall burden of comorbidities significantly reduces sleep duration in ICU patients [42].

It is important to emphasize that environmental factors such as noise, light, and frequent interventions are not the only causes of disturbed sleep. Medications such as benzodiazepines and corticosteroids can also disrupt sleep architecture [22]. Sedatives and analgesics, including opioids, are among the most frequently prescribed medications in the ICU, with more than 90% of patients receiving them at some point during hospitalization [43]. In addition to pharmacological measures, non-pharmacological methods such as music therapy, earplugs, and eye masks are recommended to improve sleep quality among ICU patients [44, 45]. Furthermore, family involvement strengthens emotional support and helps alleviate patients' feelings of isolation and loneliness [46]. Studies on healthy individuals suggest that environmental factors have a greater impact on

the subjective perception of sleep quality than on objective parameters, underscoring the multifactorial nature of sleep disturbances [47].

## Limitations

This study has several limitations. It relied solely on subjective assessments without objective measurements of sleep quality or environmental conditions, which may reduce the precision of the results. Additionally, the study was conducted on a relatively small sample from a single clinical center, which limits the generalizability of the results.

## Recommendations for Future Research

Future studies should incorporate objective methods such as polysomnography or actigraphy, as well as direct measurements of noise intensity (in decibels) and light levels (in lux). Interventional studies evaluating the effects of earplugs, eye masks, optimized lighting, and the implementation of designated "quiet hours" are also recommended. Long-term outcomes, including cognitive recovery, delirium, and post-traumatic stress disorder, should be monitored, with analyses conducted across different types of ICUs to identify organizational factors that support better sleep. Larger multicenter samples are needed to enhance representativeness, and longitudinal studies are required to assess the persistence of sleep disorders and their impact on recovery and quality of life. In addition, combining objective instruments with qualitative approaches could provide deeper insight into patient experiences and the effectiveness of sleep promoting interventions in the ICU.

## Implications for Clinical Practice and Education

The results highlight the need for systematic optimization of environmental conditions in the ICU and for staff education on the importance of sleep preservation. Identifying high-risk patients and implementing individualized sleep management strategies could contribute to faster recovery, fewer complications, and an overall improvement in the quality of care.

# CONCLUSIONS

This study demonstrated that patients experience significantly reduced sleep quality during their stay in the intensive care unit (ICU). This result is reflected in a marked decline in the subjective assessment of sleep quality. In accordance with the study objective of examining environmental factors, the most frequently identified sources of sleep disruption were infusion pump alarms, the measurement of vital parameters, and the presence of medical equipment. Auditory signals, particularly those emitted by infusion pumps, showed the strongest association with poorer sleep perception. Light was also recognized as a disturbance, although its individual impact was smaller. Pain had a negative effect on sleep quality, while diagnostic tests and blood sampling had a positive effect on the sleep quality of patients treated in the intensive care unit. Overall, the results highlight the need to develop strategies that reduce noise exposure and optimize nighttime medical activities.

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**Author Contributions**

Conceptualization, K.P., I.M. and N.F.; Methodology, Z.G., Ž.D and G.R.; Software, M.Č., Ž.D., Z.G. and M.C.; Validation, M.Č., Z.G. and G.R.; Formal Analysis, M.Č., N.F. G.R. and M.C.; Investigation, K.P., I.M.; Resources, K.P. and Ž.D.; Data Curation, K.P., I.M.; Writing – Original Draft Preparation, K.P., N.F.; Writing – Review & Editing, K.P., I.M., Z.G., Ž.D., M.Č., G.R., M.C. and N.F.; Visualization, M.Č., G.R. and Ž.D.; Supervision, Z.G. and N.F.; Project Administration, K.P., I.M. and M.C.

**Declaration of Conflicting Interest:**

The author declares no conflict of interest.

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