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# Sleep quality: a critical determinant of perceived quality of life in the administrative-technical workers of an Italian university

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**Abstract. – OBJECTIVE: This observational study aims to analyze the quality of life of the administrative/technical employees of the University of Ferrara and its relationship with sleep quality, chronotype, and family components.**

**PATIENTS AND METHODS: We invited all employees (528) to fill a data collection form (age, gender, education level, number of family components, being caregiver and job-related factors) and 3 anonymous questionnaires (VR-12 Health-Related Quality of Life, Pittsburgh Sleep Quality Index, and Morningness-Eveningness Questionnaire).**

**RESULTS: Out of 323 respondents, 72.5% were female, 76.4% had an age between 41-60 years old, 63.8% had a university degree, and 67.5% an administrative profile. Considering family-related characteristics: 81.1% of respondents lived with ≥2 people 35.3% had children, and 31.9% declared to be caregiver of a family member, not necessarily co-housing. Most of the employees resulted to be Morning-type (48.6%) and Intermediate-type (46.8%), with a very limited group of Evening-types (4.6%). Quality of sleep resulted to be the main factor affecting the health-related quality of life. Near half of our sample had poor sleep quality (49.2%; 95% CI: 43.6-54.8%). PSQI score resulted in significantly higher for people who were caregivers of a familiar (7.0 ± 3.6 *vs*. 6.1 ± 3.6, *p*=0.022). Family size and being caregiver of a familiar resulted significant factors for sleep quality, and indirectly for health-related quality of life.**

**CONCLUSIONS: The quality of sleep is the most influencing parameter of the workers' quality of life. Family size and being caregiver of a family member indirectly affect the quality of life by influencing sleep quality. Appropriate consideration and management of these aspects in the working context could improve workers' well-being.**

*Key Words:*
Quality of life, Sleep, Sleep quality, Circadian rhythms, Chronobiology, Chronotype, Family component, Caregiver, Administrative/technical employees, White collar.

## Introduction

World Health Organization (WHO) defines quality of life as an "individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad-ranging concept affected in a complex way the person's physical health, psychological state, personal beliefs, social relationships and their relationship to salient features of their environment"[1]. In this extremely wide concept, many factors have been proved to be associated with quality of life (QoL). For assessment of QoL, generic and specific questionnaires have been developed, designed to be applicable across a wide range of populations and interventions. These questionnaires produce a combination of two summary measurements of health-related quality of life: a physical component summary score, which represents physical Health-Related Quality of Life (HRQoL), and a mental component summary score, which represents mental HRQoL. Considering the multifaceted nature of quality of life, it is important to ensure that the well-being framework is inclusive of all contexts, even if there is no consensus on which variables are the most appropriate to measure and report physical and mental health-related quality of life.

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On one hand, social-demographic characteristics, such as gender, age, and education, were all found to be correlated with HRQoL[2-4] with older age independently associated with lower physical HRQoL for both genders[5]. On the other, sleep and specific sleep characteristics are crucial indicators of HRQoL[6]. Sleep in most humans occupies between 20% and 40% of day[7]. Generally, 7 to 9 hours of sleep are recommended in an adult but sleep needs vary significantly among individuals, and many factors can affect how many hours an individual needs (e.g., pregnancy, aging, previous sleep deprivation, and sleep quality)[8].

One of the most popular, well-established and validated clinical tools used to collect both direct and indirect measurements of subjective sleep quality is The Pittsburgh Sleep Quality Index (PSQI)[9]. The subjective measurements evaluated can be either direct, including self-reported sleep quality and satisfaction, average sleep duration and sleep efficiency (sleep latency and wake after sleep onset), or indirect, such as self-perceived sleepiness, unintentional napping during working hours, and academic performance. The psychometric properties of PSQI, such as internal consistency, test-retest reliability, validity, and factorial structure, are the most used by clinicians and researchers, and PSQI has been validated in many populations and languages[10], including Italian[11].

The majority of studies[12,13] have investigated the relationship between sleep and health-related quality of life in specific populations of patients. It has been shown[7,14-16] that every aspect of quality of life is negatively impacted by reduced sleep quantity or poor sleep quality. The causes of sleep loss fall under two major, somewhat overlapping, categories: lifestyle/occupational (e.g., shift work, prolonged working hours, jet lag, irregular sleep schedules) and sleep disorders (e.g., insomnia, sleep-disordered breathing, restless legs syndrome, narcolepsy and circadian rhythm disorders). Insomnia, defined by having difficulty falling asleep, maintaining sleep, or by short sleep duration, despite adequate opportunity for a full night's sleep, is the most reported sleep problem[17]. There are different types of insomnia (Short-Term Insomnia and Chronic Insomnia) and its precise causes are poorly understood but stress is thought to play a leading role in activating the hypothalamic-pituitary axis and setting the stage for chronic insomnia[18]. Vgontzas et al[19] showed that adults with insomnia, compared with normal sleepers, have higher levels, over a 24-hr period, of cortisol and adrenocorticotropic hormone (ACTH), hormones released by the hypothalamic-pituitary-adrenal axis after stress exposure. With regards to the working population, the impact of sleep deficiency on quality of life, cardiovascular disease risk and performance level on the job has been mainly demonstrated in health-professional shift workers[20-24]. Data examining sleep conditions and, in particular, the possible influence of sleep on HRQoL in white-collar workers are, however, lacking.

Another important aspect to consider when evaluating the quality of life is chronotype, a characteristic that constitutes inter-individual differences in the circadian phase and calls for a specific preference for sleep and activity timing. Chronotypes are divided into the terms "morning-oriented types" (M-types) and "evening-oriented types" (E-types), to distinguish people showing an extreme preference for morning or evening activity, respectively[25]. However, most individuals can be categorized as Intermediate-type (I-type), with a possible propensity towards M-types and E-types. Some authors[26-28] suggest that circadian misalignment, and consequent sleep disruption may lead to either short- or long-term health consequences. Individual chronotype determines different habits, including diet and lifestyle from a young age; E-type students have been shown to exhibit significantly lower intake of fruits, vegetables, cereals, olive oil, and higher breakfast- skipping[29]. Moreover, a growing amount of evidence shows that eveningness may impact general health, either physical or mental, sleep, school results and achievements, especially in younger age and in women[30]. Most of the studies on chronotype conducted in working contexts are focused on shift workers as this category is believed to be at increased risk of either metabolic problems[31], anxiety and fatigue[32], reflecting also on poor HRQoL[33]. However, chronotype may have an impact also on daytime workers and, thus, is worth investigating.

In addition to sleep and chronotype, the family context has an important influence on QoL, specifically family composition, i.e., number of members, in particular children, presence of people needing assistance, and being a caregiver. In fact, being the caregiver of a family member is potentially an increased risk for adverse effects on the well-being in virtually every aspect of life, ranging from health and quality of life to the relationships and economic security[34], yet the relationship between employment and quality of

life of the caregiver has not been fully investigated. In spite of the efforts of recent years by all world organizations dealing with the safeguard and protection of quality of life of people in many contexts, the working context continues to be neglected. For this reason, our attention focused on a specific working population, the administrative employees of an Italian university, with the aim to explore if sleep, chronotype, and familiar parameters are associated with physical and mental quality of life.

## Patients and Methods

This cross-sectional study was part of the project "Lavorare bene in Unife" ("Working well at the University of Ferrara"). This project, actively sponsored by the University of Ferrara and performed in collaboration with the working group "Tavolo Tecnico per il benessere lavorativo", was carried out in March-April 2018 with the purpose of taking a comprehensive picture of workers' wellbeing, and possibly attempting to identify and promote job-related strategies aimed to improve it. The project involved all the administrative/technical personnel of the University of Ferrara (including temporary contract workers), who were invited to preliminarily attend an informative seminar dealing with the organization and desynchronization of circadian rhythms, and the individual circadian preference (chronotype). On a voluntarily basis, participants were then asked to complete an online survey based on specific questionnaires, at their personal working desk, in complete privacy conditions. Out of 528 employees, 343 (66%) attended the seminar, and 323 (94%) voluntarily agreed to participate in the survey. During the seminar, the investigators explained the research content, presented the questionnaires, and gave instructions on how to fill in the online form. All the participants received an email with a link to the survey, in order to collect the data in a completely anonymous way. Participants were asked to complete three questionnaires: one on chronotype (Morningness-Eveningness Questionnaire, MEQ), one on sleep quality (Pittsburgh Sleep Quality Index, PSQI), and one on health-related quality of life (Veterans RAND 12-Item Health Survey, VR-12), in combination with questions regarding socio-demographic and job-related factors. The questions were not of any ethical concern. The flow-chart with gender distribution details is presented in Figure 1.

### Measures and Questionnaires

The Morningness-Eveningness Questionnaire (MEQ) consists of 19 self-reported items in a Likert scale response format pertaining to habitual rising and bedtimes, preferred behavioral sleep schedules and alertness in the morning[25]. MEQ score ranges from 16 to 86, with higher scores reflecting stronger preference for morningness and lower scores reflecting stronger preference for eveningness[35]. Participants who score between 59 and 86 are classified as M-types ("larks"), those who score between 42 and 58 as intermediate (I-types) and those with a score ≤41 as E-types ("owls"). MEQ has been established as a reliable and valid measurement of chronotype[36].

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a self-rated questionnaire designed to evaluate 7 components of sleep over the past month: perceived sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medications and daytime dysfunction due to sleepiness. Each component yields a score ranging from 0 to 3, with 3 indicating the greatest dysfunction. The seven components can be summed up to produce

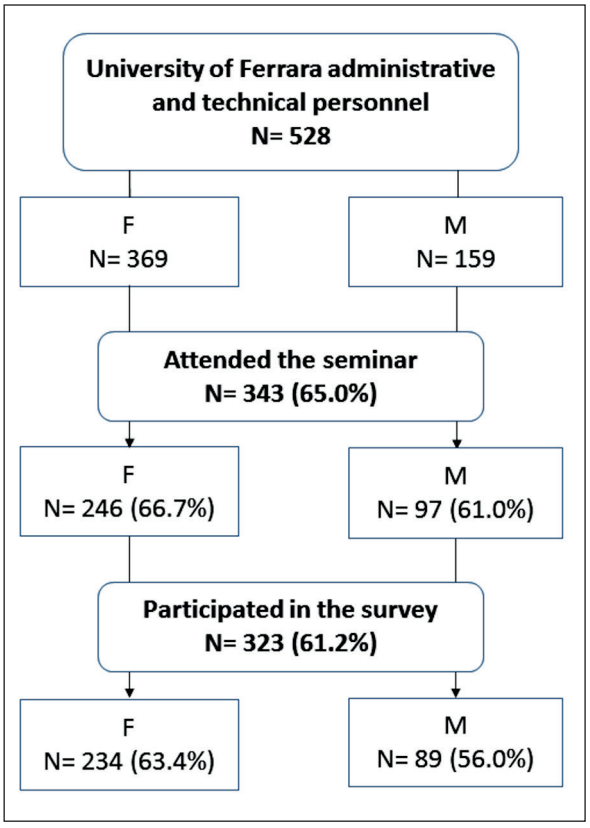


**Figure 1.** Flow-chart of the study.

a total score ranging from 0 to 21, with higher scores indicating worse sleep quality[9,11]. A global score >5 is suggestive of poor sleep quality[11,37].

The Veterans RAND 12-Item Health Survey was used to assess the physical and mental health-related quality of life[38]. The VR-12 yields 9 items and two component scores: Physical Component Summary (PCS) and Mental Component Summary (MCS). Both the components are standardized with a mean of 50 and a standard deviation of 10 and higher scores denote better physical and mental health status, respectively. We have decided to use the VR12 revisiting the validated SF12 Italian version plus two questions on the perception of health status as compared to the previous year, translated into Italian for the study. The VR-12 has reported excellent reliability and validity[38,39].

All participants provided complete information on their age class (≤30, 31-40, 41-50, 51-60, >60 years), gender and education level (middle school or lower, high school, bachelor degree, higher degree). Family status was recorded as number of family components, number of children (<14 years) and being caregiver of any familiars (cohabiting or not).

Job-related factors were: type of contract (permanent or fixed-term), job profile (administrative or technician), working years (≤10, 11-20, >20), job position (B, C, D, EP) and distance between home and workplace (<10 km, 10-25 km, 25-50 km, >50 km). Job position was defined according to Italian professional categories that differ according to: degree of autonomy, degree of responsibility, and the educational level required to apply for the professional category. Category B represents the lower level (carrying out basic tasks, and requiring high-school qualification), while EP is the highest (solving complex organizational and/or professional tasks, and requiring a degree and a higher professional qualification).

### Statistical Analysis

Continuous data were reported through mean and standard deviation (SD), while categorical variables were described through absolute and relative frequencies (%).

Questionnaires scores distribution was graphically inspected using histograms. PCS and PSQI scores were transformed to reach an approximately normal distribution. Square root was applied to PSQI while PCS was cubed-transformed (PCS^3). We decided to apply these monotonic transformations in order to preserve interpretability, as an increase in the transformed variable corresponds to an increase in the original. All the analyses were carried out on transformed variables.

Correlation between VR-12 scores and PSQI was measured with Pearson's linear correlation coefficient. The association between questionnaire scores and categorical factors was tested with the Student *t*-test (k=2 categories) and the ANOVA (k>2 categories). Significant variables were considered for path analysis. Path analysis consists in a system of equations in which the structural relationships between the observed variables are modelled. This type of structural equation modelling (SEM) is used when a variable is thought to mediate the relationship between two others (mediation models)[40,41]. We assumed that sleep quality could be a mediator between the quality of life and the other socio-demographics and job-related characteristics. This assumption allowed studying indirect pathways from explanatory variables to quality of life via sleep quality.

The path analysis was conducted using the SEM Stata command. Three linear regressions were simultaneously estimated, including sleep quality and the two VR-12 components as dependent variables. Sleep quality was also entered as an explanatory variable (mediator) in the equations on VR-12 scores. Regression models were simplified with backward selection using the likelihood ratio test. Estimates from the final structural equation model were reported as standardized coefficients and 95% confidence intervals (95%CI). Negative coefficients were suggestive of a decrease in the outcome variable while positive coefficients indicated an increase.

Statistical significance was set at 0.05 α level. The analyses were performed using Stata statistical software, version 13 (StataCorp, College Station, TX, USA).

## Results

Socio-demographic and job-related characteristics of the study population are shown in Table I. Out of 323 respondents, 72.5% were female, 76.5% aged between 41 and 60 years old, and only 4 subjects under 30 years old. The majority of subjects had a university degree (63.8%), an administrative profile (67.5%), and belonged to the professional category C (61.6%). The percentages

**Table I.** Demographic, family and job-related characteristics of the studied population (N=323).

| Demographics | N (%) | Job-related Characteristics | N (%) |
|---|---|---|---|
| Female gender | 234 (72.5) | Job profile | |
| Age (years) | | Administrative | 218 (67.5) |
| ≤ 40 | 46 (14.2) | Technician | 105 (32.5) |
| 41-50 | 123 (38.1) | Job position | |
| 51-60 | 124 (38.4) | B | 32 (9.9) |
| > 60 | 30 (9.3) | C | 199 (61.6) |
| Educational attainment | | D | 79 (24.5) |
| Middle school | 16 (4.9) | E | 13 (4.0) |
| High school | 101 (31.3) | Work seniority (years) | |
| Bachelor degree | 156 (48.3) | ≤ 10 | 63 (19.5) |
| Higher degree | 50 (15.5) | 11-20 | 112 (34.7) |
| Chronotype | | > 20 | 148 (45.8) |
| Morning type | 157 (48.6) | Permanent contract | 302 (93.5) |
| Intermediate type | 151 (46.8) | Distance work-home | |
| Evening type | 15 (4.6) | < 10 km | 218 (67.5) |
| | | 10-25 km | 73 (22.6) |
| | | > 20 km | 32 (9.9) |
| **Family related characteristics** | **N (%)** | | |
| Family members (num.) | | | |
| 1 | 61 (18.9) | | |
| 2 | 84 (26.0) | | |
| 3 | 101 (31.3) | | |
| ≥ 4 | 77 (23.8) | | |
| Children (≤ 14 years old) | 114 (35.3) | | |
| Being caregiver | 103 (31.9) | | |

of E-types were very low (4.6%), while the proportion of M-types (48.6%) and I-types (46.8%) were significantly higher.

Considering family-related characteristics, 81.1% of respondents lived with ≥2 people; 35.3% had children and 31.9% declared to be caregiver of a family member, not necessarily cohabiting.

Females were on average younger and more frequently had an administrative profile (74.8% *vs.* 48.3%, *p*-value<0.001).

PSQI global score ranged between 0 and 19, with a median of 5 and a mean of 6.4±3.6 (Figure 2 b). Nearly half of the sample population was classified as poor sleepers (49.2%, 95% CI: 43.6-54.8%). PSQI score resulted significantly higher for people who were the caregiver of a family member (7.0 ± 3.6 *vs.* 6.1 ± 3.6, *p*=0.022) (Table II).

MCS and PCS scores ranged from 9 to 52 and 20 to 67 with a mean of 33.8 ± 6.8 and 55.2 ± 8.2, respectively (Figure 2 c-d). There was a significant moderate correlation between VR-12 scores and PSQI (MCS: r=-0.359, *p*-value<0.001; PCS: r=-0.334, *p*-value<0.001). Indeed, poor sleepers reported worse mean scores than good sleepers (PCS: 53.0±8.7 *vs.* 57.3±7.1, *p*<0.001; MCS: 32.0±6.5 *vs.* 35.6±6.6, *p*<0.001). The associations between VR-12 scores and the other factors are reported in Table II. Women showed significantly lower mean scores, while age was directly associated with PCS, but inversely to MCS: people older than 60 years reported on average higher MCS 37.5 ± 6.4 and lower PCS 50.6 ± 9.3 scores as compared to young employees (*p*-values <0.02). MCS varied significantly also with education level and job profile. PCS instead significantly correlated with chronotype, job position and family characteristics. In particular, PCS mean score increased with family size and in presence of children, while it decreases moving to evening chronotype and clerical workers (B category).

Most of the associations were confirmed in path analysis; results are shown in Table III and Figure 3. The main factor affecting the health-related quality of life was quality of sleep with standardized coefficients 2-3 times higher than those of the other covariates. Family-related characteristics resulted in significant factors for sleep quality and indirectly for health-related quality of life. In particular, the increase in family size resulted in a protective factor while being a

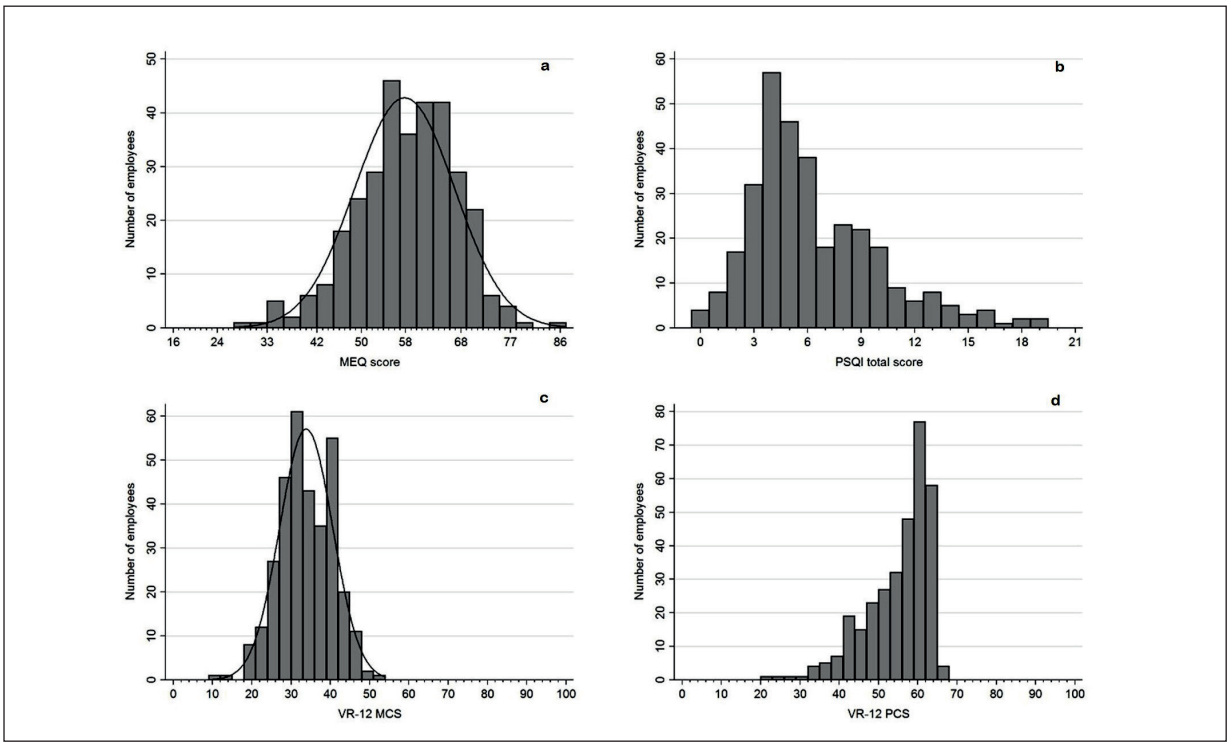


**Figure 2.** Histogram of questionnaires scores distribution: **(a)** MEQ; **(b)** PSQI; **(c)** VR-12 MCS; **(d)** VR-12 PCS.

caregiver of a family member was a risk factor for poor quality of sleep and indirectly for worse health-related QoL.

## Discussion

The present study explored a non-clinical sample of 323 daytime workers of the University of Ferrara, Italy, to evaluate the relationship between quality of life and three important determinants: sleep, chronotype and family characteristics. To the best of our knowledge, this is the first study dealing with quality of life conducted in the public administration sector.

Our results confirmed that quality of sleep represents the main factor affecting the quality of life. Among the population recruited, nearly half of the sample was classified as poor sleepers (49.2%), resulting in slightly higher prevalence than the previously reported on daytime workers and general populations[42-44]. Indeed, in former studies on daytime workers, the poor sleep prevalence varied between 40% to 43%, often with higher rates in women than in men, whereas in a representative Austrian general population sample of over 15 years of age, it was 32.1% (37% females, 26.5% males)[45]. The increased prevalence in our sample could be explained by the fact that it mostly comprises middle-age workers (40-60 years old), of whom 72.5% were females, and it is well known that sleep quality decreases with increasing age, especially in women. In fact, our results are in line with an Italian study on middle-aged people, including 71.5% of women, that reported a prevalence of 49.4% poor sleepers[46]. Similar frequencies were reported in surveys on menopausal middle-aged women[47]. The strong relationship between quality of life and quality of sleep has already been reported[6], although mostly on general population and patients with various pathologies[48].

In our daytime workers, chronotype was also related to the quality of life. In particular, MEQ was positively associated with VR-12 physical components and the transition from evening to morning chronotype results in better PCS. Other studies have analyzed these relationships but with different results. Suh et al[35] found a significant relationship with both physical and mental components of QOL, while Sasawaki et al[49] reported no significant relationship. One possible explanation could be again ascribed to the different types of populations examined: Sasawaki analyzed 126

**Table II.** Factors associated to PSQI, VR12 physical component score (PCS) and mental component score (MCS).

| | PSQI mean ± SD | *p*-value* | VR12 MCS mean ± SD | *p*-value* | VR12 PCS mean ± SD | *p*-value* |
|---|---|---|---|---|---|---|
| Gender | | 0.090 | | **0.002** | | **0.049** |
| M | 5.8 ± 3.3 | | 35.7 ± 6.6 | | 56.5 ± 8.2 | |
| F | 6.6 ± 3.8 | | 33.1 ± 6.7 | | 54.7 ± 8.2 | |
| Age (years) | | 0.647 | | **0.019** | | **0.014** |
| ≤ 40 | 6.3 ± 3.6 | | 33.2 ± 6.8 | | 56.4 ± 6.8 | |
| 41-50 | 6.2 ± 3.5 | | 33.5 ± 6.3 | | 55.2 ± 8.7 | |
| 51-60 | 6.5 ± 4.0 | | 33.5 ± 7.1 | | 55.9 ± 7.6 | |
| > 60 | 6.9 ± 3.0 | | 37.5 ± 6.4 | | 50.6 ± 9.3 | |
| Educational attainment | | 0.650 | | **0.029** | | 0.129 |
| Middle school | 5.5 ± 2.5 | | 36.3 ± 7.8 | | 50.9 ± 8.7 | |
| High school | 6.5 ± 3.9 | | 34.8 ± 7.2 | | 54.9 ± 8.6 | |
| Bachelor degree | 6.4 ± 3.5 | | 32.7 ± 6.4 | | 55.7 ± 7.8 | |
| Higher degree | 6.1 ± 4.0 | | 34.5 ± 6.4 | | 55.6 ± 8.2 | |
| Chronotype | | 0.431 | | 0.514 | | **0.032** |
| Morning type | 6.2 ± 3.7 | | 34.2 ± 7.0 | | 56.3 ± 7.5 | |
| Intermediate type | 6.5 ± 3.5 | | 33.6 ± 6.6 | | 54.5 ± 8.4 | |
| Evening type | 7.1 ± 4.5 | | 32.3 ± 6.0 | | 51.2 ± 10.9 | |
| Job profile | | 0.072 | | **0.006** | | 0.909 |
| Administrative | 6.6 ± 3.7 | | 33.1 ± 6.7 | | 55.3 ± 7.9 | |
| Technician | 5.9 ± 3.6 | | 35.3 ± 6.6 | | 55.0 ± 8.7 | |
| Job position | | 0.452 | | 0.276 | | **0.032** |
| B | 6.3 ± 3.6 | | 35.1 ± 8.5 | | 51.3 ± 9.9 | |
| C | 6.1 ± 3.6 | | 33.6 ± 6.7 | | 55.9 ± 7.6 | |
| D | 6.9 ± 3.9 | | 34.2 ± 6.4 | | 54.8 ± 8.8 | |
| E | 6.5 ± 2.4 | | 31.0 ± 5.4 | | 57.5 ± 7.0 | |
| Work seniority (years) | | 0.219 | | 0.056 | | 0.030 |
| ≤ 10 | 6.4 ± 3.7 | | 33.5 ± 6.6 | | 57.7 ± 5.8 | |
| 11-20 | 5.9 ± 3.5 | | 32.8 ± 6.6 | | 55.1 ± 8.5 | |
| > 20 | 6.7 ± 3.7 | | 34.8 ± 6.9 | | 54.2 ± 8.7 | |
| Type of contract | | 0.302 | | 0.163 | | 0.934 |
| Fixed-term | 5.6 ± 2.7 | | 35.8 ± 6.5 | | 55.0 ± 8.7 | |
| Permanent | 6.4 ± 3.7 | | 33.7 ± 6.8 | | 55.2 ± 8.2 | |
| Distance work-home | | 0.521 | | 0.880 | | 0.145 |
| < 10 km | 6.4 ± 3.7 | | 33.7 ± 6.6 | | 55.0 ± 8.0 | |
| 10-25 km | 6.0 ± 3.5 | | 34.2 ± 7.7 | | 56.3 ± 8.7 | |
| > 20 km | 6.7 ± 3.5 | | 33.7 ± 6.2 | | 53.9 ± 8.3 | |
| Family members (num.) | | 0.151 | | 0.297 | | **0.013** |
| 1 | 7.3 ± 4.3 | | 33.5 ± 7.4 | | 53.0 ± 9.3 | |
| 2 | 6.5 ± 3.6 | | 34.8 ± 6.9 | | 54.0 ± 8.6 | |
| 3 | 6.1 ± 3.3 | | 33.9 ± 6.5 | | 56.4 ± 7.9 | |
| ≥ 4 | 5.9 ± 3.5 | | 32.8 ± 6.3 | | 56.7 ± 6.6 | |
| Children (≤14 years old) | | 0.253 | | 0.726 | | **0.003** |
| No | 6.6 ± 3.8 | | 33.9 ± 7.1 | | 54.2 ± 8.6 | |
| Yes | 6.0 ± 3.4 | | 33.6 ± 6.2 | | 57.1 ± 7.0 | |
| Being caregiver | | **0.022** | | 0.832 | | 0.143 |
| No | 6.1 ± 3.6 | | 33.8 ± 6.8 | | 55.8 ± 7.5 | |
| Yes | 7.0 ± 3.6 | | 33.9 ± 6.8 | | 54.0 ± 9.5 | |

**p*-values refer to parametric tests (*t*-test and oneway ANOVA) on transformed variables: square-root (PSQI) and PCS^3. In bold significant *p*-values.

daytime office workers with a median age of 29 (IQ range: 26-36); while Suh examined a population-based cohort with age ranging from 49 to 79. With regard to chronotype, an unexpected finding of our study was that it did not significantly affect PSQI. This result may appear to be in contrast with those reported in previous studies, where E-types in particular were found to have a worse PSQI score than M- and I-types[37,50,51] and to suffer from sleep disturbances[35,51]. Our results can likely be due to the low number of E-types present in our sample. Analyzing the PSQI com-

**Table III.** SEM results. Standardized coefficients (Coef.) and *p*-values from likelihood ratio test.

| Outcome | Explanatory variables | Coef. | 95% CI | *p*-value |
|---|---|---|---|---|
| VR12 PCS | | | | |
| | PSQI | -0.302 | -0.398 – -0.207 | < 0.001 |
| | Female | -0.109 | -0.207 – -0.010 | 0.031 |
| | Age > 60 | -0.153 | -0.252 – -0.055 | 0.002 |
| | MEQ | +0.173 | 0.078 – 0.268 | < 0.001 |
| | B category | -0.134 | -0.229 – -0.038 | 0.006 |
| | Work seniority ≤ 10 years | +0.134 | 0.037 – 0.230 | 0.007 |
| VR12 MCS | | | | |
| | PSQI | -0.365 | -0.448 – -0.273 | < 0.001 |
| | Female | -0.114 | -0.213 – -0.015 | 0.024 |
| | Age > 60 | +0.149 | 0.046 – 0.251 | 0.005 |
| | Work seniority > 20 years | +0.107 | 0.006 – 0.208 | 0.038 |
| PSQI | | | | |
| | Family number (num.) | -0.125 | -0.231 – -0.019 | 0.021 |
| | Being caregiver | +0.129 | 0.023 – 0.235 | 0.017 |

ponents, we found an extremely high proportion of sleep disturbances (approximately 93%), with no differences among chronotypes. It could be speculated that working time, in addition to family and social habits, may have strongly affected the biological chronotype of our study population, inducing a switch from E-type to I-type and M-type, with the consequence of frequent sleep disturbances.

Unlike chronotype, two family-related characteristics were found to be significant factors for sleep quality and so, indirectly, for health-related quality of life: (a) the increase in family size (protective factor), and (b) being a caregiver of a family member (risk factor). It is somewhat difficult to compare this result with the available literature, since family size is a parameter mainly used in socio-economic assessments to evaluate children's well-being. An American poll, sponsored and funded by the National Sleep Foundation "Sleep in the Modern Family", had the goal of presenting a contemporary picture of sleep in families with at least 1 school-aged child, but the possible effect of the number of

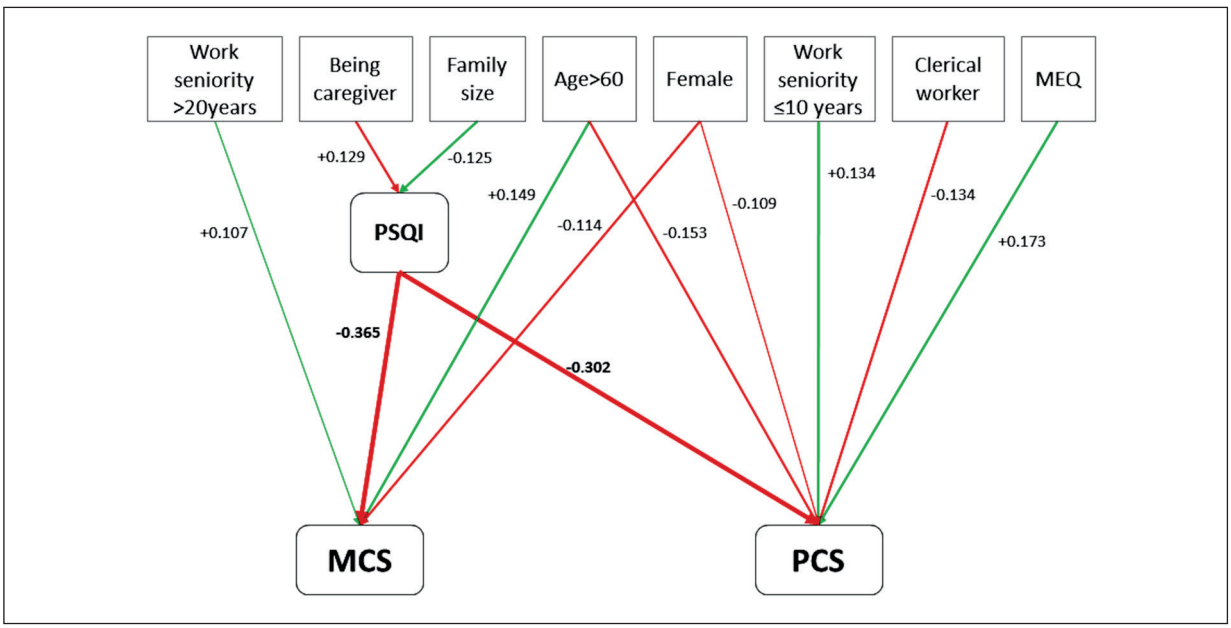


**Figure 3.** Path analysis diagram. *Arrows* width is proportional to the standard coefficient reported in Table III. Red and green *arrows* indicate a negative and positive effect, respectively.

family members was not analyzed. The majority of the other studies on sleep quality in families have been focused on parents with children affected by particular chronic pathologies. Only one study, conducted in Iran, has considered family size in relationship with sleep quality[52]. This study, including healthy 50-60 year-old women, reported a non-significant correlation between women's sleep quality and their family size. However, the sample comprised more than 90% housewives with ≥3 children and thus living in a big family, whereas in our sample, almost 20% live alone and 26% with just one other person. So, viewed in the opposite direction, we could interpret that people who live alone are at higher risk of poor sleep. Substantial evidence from the literature shows that less social contact and, in particular, living alone significantly correlates with poor sleep and this considerably reduces health-related quality of life[53,54]. Finally, as for the role of caregiver, our results confirm previous findings of sleep disorders affecting the quality of life of people who take care of ill family members, especially the elderly with dementia or more severe diseases[55,56]. Indeed, disease and incapacity are common experiences that represent one of the greatest challenges for families, since the psychosocial problems caused by a person with dependence have an impact on the whole family circle resulting in a deterioration of their QoL[57].

A noteworthy strength of this study is the selected population of early-age-start workers. Thus, the results are more generalizable to working and general populations than those arising from clinical cohorts. Moreover, the sample of employees who replied to the survey was large and representative of the University of Ferrara's entire administrative/technical personnel. Also, most of our population live in Ferrara: a small town (150,000 inhabitants) where most people utilize bicycles and no more than 30 minutes are required for travelling back and forth to the workplace. As all our participants have the same working hours, they are all exposed to the same type of discomfort, such as traffic, weather conditions, etc.

We are aware, however, that this observational study has some limitations. First, the study was cross-sectional, so we cannot assess the causal nature of the associations. But, the use of a path analysis allows a better understanding of the links between the different factors and the mechanisms of their association. Second, this study relied solely on self-reported questionnaires and, although in the presence of fully validated scales, it could have given less reliable results compared to other applied objective measurements. Nevertheless, it would have been difficult and expensive to use less subjective instruments, because of the large sample size. Furthermore, a recent multi-instrument analysis concluded that sleep quality is the strongest independent predictor of health and in particular mental health and more so in women than in men[58]. Third, factors that can influence the quality of life, such as chronic disease, physical activity, nicotine and caffeine use, and varied occupational variables were not investigated. In particular, our purpose for future studies is to examine other working variables (work ability, work performance, relation with colleagues and supervisor, work satisfaction, control over work tasks, absence/presence due to sickness) to offer more detailed discussions on how the working style can influence a worker's life and sleep.

## Conclusions

In our University administrative population, poor sleep quality was the main significant risk factor for the quality of life. Thus, everything that affects sleep quality worsens the quality of life. We are in agreement with economics experts, saying that "people spend large portions of their lives working, often to the detriment of sleep. Employers often ignore the importance of employee sleep despite evidence showing sleep health is crucial to positive employee" outcomes[59]. Workplace health promotion planners should take into account measures aimed to improve sleep quality, and, therefore, health-related quality of life of workers.

### Conflict of Interest

There are no financial or other conflicts of interest incurred by any of the authors due to funding sources, or utilized products, technology, or methods of our research and report of findings.

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## Authors' Contribution

Conceptualization, R.M., P.B., and M.S.; methodology, El.M., Ed.M., and E.B.; software, El.M., Ed.M., and E.B.; validation, El.M., R.M., P.B., and M.S.; formal analysis, El.M.; investigation, El.M., E.B., R.M., P.B., and M.S.; resources, R.M., and P.B.; data curation, El.M., Ed.M., E.B., and M.S.; writing-original draft preparation, El.M., Ed.M., E.B., and M.S.; writing-review and editing, R.M., P.B., and M.S.; visualization, El.M., E.B., and M.S.; supervision, R.M., P.B., and M.S.; project administration, E.B., R.M., and P.B.; funding acquisition, R.M., and P.B. All authors have read and agreed to the published version of the manuscript.

## Appendix

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## References

1) WHOQOL: Measuring Quality of Life. Available at: https://www.who.int/healthinfo/survey/whoqol-qualityoflife/en/.
2) Mercier C, Peladeau N, Tempier R. Age, gender and quality of life. Community Ment Health J 1998; 34: 487-500.
3) Song T, Ding YW, Sun Y, He YN, Qi DJ, Wu Y, Wu B, Lang L, Yu K, Zhao X, Zhu LL, Wang S, Yu XS. A population-based study on health-related quality of life among urban community residents in Shenyang, Northeast of China. BMC Public Health 2015; 15: 921.
4) Pappa E, Chatzikonstantinidou S, Chalkiopoulos G, Papadopoulos A, Niakas D. Health-related quality of life of the Roma in Greece: the role of socio-economic characteristics and housing conditions. Int J Environ Res Public Health 2015; 12: 6669-6681.
5) Jalali-Farahani S, Amiri P, Bakht S, Shayeghian Z, Cheraghi L, Azizi F. Socio-demographic determi-nants of health-related quality of life in Tehran Lipid and Glucose Study (TLGS). Int J Endocrinol Metab 2017; 15: e14548.
6) Dunleavy G, Tonon AC, Chua AP, Zhang Y, Cheung KL, Thach TQ, Rykov Y, Soh CK, Christopoulos G, de Vries H, Car J. A multifactorial approach to sleep and its association with health-related quality of life in a multiethnic Asian working population: a cross-sectional analysis. Int J Environ Res Public Health 2019; 16: 4147.
7) Grandner MA. Sleep, health, and society. Sleep Med Clin 2020; 15: 319-340.
8) Olson EJ. How many hours of sleep are enough for good health? Available at: https://www.mayoclinic.org/healthy-lifestyle/adult-health/expert-answers/how-many-hours-of-sleep-are-enough/faq-20057898.
9) Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989; 28: 193-213.
10) Wong WS, Fielding R. Prevalence of insomnia among Chinese adults in Hong Kong: a population-based study. J Sleep Res 2011; 20: 117-126.
11) Curcio G, Tempesta D, Scarlata S, Marzano C, Moroni F, Rossini PM, Ferrara M, De Gennaro L. Valid-ity of the Italian version of the Pittsburgh Sleep Quality Index (PSQI). Neurol Sci 2013; 34: 511-519.
12) Hammersen F, Lewin P, Gebauer J, Kreitschmann-Andermahr I, Brabant G, Katalinic A, Waldmann A. Sleep quality and health-related quality of life among long-term survivors of (non-) Hodgkin lymphoma in Germany. PLoS One 2017; 12: e0187673.
13) Liu H.-X, Lin J, Lin X.-H, Wallace L, Teng S, Zhang S.-P, Hao Y.-F. Quality of sleep and health-related quality of life in renal transplant recipients. Int J Clin Exp Med 2015; 8: 16191-16198.
14) Khalil M, Power N, Graham E, Deschenes SS, Schmitz N. The association between sleep and diabe-tes outcome – A systematic review. Diabetes Res Clin Pract 2020; 161: 108935.
15) Ahmad A, Didia SC. Effects of sleep duration on cardiovascular events. Curr Cardiol Rep 2020; 22: 18.
16) Sun J, Wang M, Yang L, Zhao M, Bovet P, Xi B. Sleep duration and cardiovascular risk factors in children and adolescents: a systematic review. Sleep Med Rev 2020; 53: 101338.
17) Ohayon MM. Epidemiology of insomnia: what we know and what we still need to learn. Sleep Med Rev 2002; 6: 97-111.
18) Insomnia. What it is, how it affects you, and how to help you get back your restful nights. Avail-abke at: https://www.sleepfoundation.org/insomnia/types-of-insomnia.
19) Vgontzas AN, Bixler EO, Lin HM, Prolo P, Mastorakos G, Vela-Bueno A, Kales A, Chrousos GP. Chronic insomnia is associated with nyctohemeral activation of the hypothalamic-pituitary-adrenal axis: clinical implications. J Clin Endocrinol Metab 2001; 86: 3787-3794.
20) Di Muzio M, Dionisi S, Di Simone E, Cianfrocca C, Di Muzio F, Fabbian F, Barbiero G, Tartaglini D, Giannetta N. Can nurses' shift work jeopardize the patient safety? A systematic review. Eur Rev Med Pharmacol Sci 2019; 23: 4507-4519.

21) Di Simone E, Fabbian F, Giannetta N, Dionisi S, Renzi E, Cappadona R, Di Muzio M, Manfredini R. Risk of medication errors and nurses' quality of sleep: a national cross-sectional web survey study. Eur Rev Med Pharmacol Sci 2020; 24: 7058-7062.

22) Cappadona R, Di Simone E, De Giorgi A, Boari B, Di Muzio M, Greco P, Manfredini R, Rodríguez-Borrego MA, Fabbian F, López-Soto PJ. Individual circadian preference, shift work, and risk of med-ication errors: a cross-sectional web survey among Italian midwives. Int J Environ Res Public Health 2020; 17: E5810.

23) Boutou A, Pitsiou G, Sourla E, Kioumis I. Burnout syndrome among emergency medicine physicians: an update on its prevalence and risk factors. Eur Rev Med Pharmacol Sci 2019; 23: 9058-9065.

24) Puttonen S, Härmä M, Hublin C. Shift work and cardiovascular disease - pathways from circadian stress to morbidity. Scand J Work Environ Health 2010; 36: 96-108.

25) Horne JA, Ostberg O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. Int J Chronobiol 1976; 4: 97-110.

26) Medic G, Wille M, Hemels ME. Short- and long-term health consequences of sleep disruption. Nat Sci Sleep. 2017; 9: 151-161.

27) Manfredini R, Fabbian F, De Giorgi A, Zucchi B, Cappadona R, Signani F, Katsiki N, Mikhailidis DP. Daylight saving time and myocardial infarction: should we be worried? A review of the evidence. Eur Rev Med Pharmacol Sci 2018; 22: 750-755.

28) Manfredini R, Fabbian F, Cappadona R, Modesti PA. Daylight saving time, circadian rhythms, and cardiovascular health. Intern Emerg Med 2018; 13: 641-646.

29) Rodríguez-Muñoz PM, Carmona-Torres JM, Rivera-Picón C, Fabbian F, Manfredini R, Rodríguez-Borrego MA, López-Soto PJ. Associations between chronotype, adherence to the Mediterranean diet and sexual opinion among university students. Nutrients 2020; 12: 1900.

30) Fabbian F, Zucchi B, De Giorgi A, Tiseo R, Boari B, Salmi R, Cappadona R, Gianesini G, Bassi E, Signa-ni F, Raparelli V, Basili S, Manfredini R. Chronotype, gender and general health. Chronobiol Int 2016; 33: 863-882.

31) Manfredini R, Cappadona R, Fabbian F. Nurses, shift work, and diabetes: should late chronotype be considered as a risk factor? BMJ 2019; 364: l178.

32) López-Soto PJ, Fabbian F, Cappadona R, Zucchi B, Manfredini F, García-Arcos A, Carmona-Torres JM, Manfredini R, Rodríguez-Borrego MA. Chronotype, nursing activity, and gender: a systematic review. J Adv Nurs 2019; 75: 734-748.

33) Wittmann M, Dinich J, Merrow M, Roenneberg T. Social jetlag: misalignment of biological and so-cial time. Chronobiol Int 2006; 23: 497-509.

34) Wu S, Zhu W, Li H, Yu IT, Lin S, Wang X, Yang S. Quality of life and its influencing factors among medical professionals in China. Int Arch Occup Environ Health 2010; 83, 753-761.

35) Suh S, Yang HC, Kim N, Yu JH, Choi S, Yun CH, Shin C. Chronotype differences in health behaviors and health-related quality of life: a population-based study among aged and older adults. Behav Sleep Med 2017; 15: 361-376.

36) Di Milia L, Adan A, Natale V, Randler C. Reviewing the psychometric properties of contemporary circadian typology measures. Chronobiol Int 2013; 30: 1261-1271.

37) Gobin CM, Banks JB, Fins AI, Tartar JL. Poor sleep quality is associated with a negative cognitive bias and decreased sustained attention. J Sleep Res 2015; 24: 535-5n42.

38) Berlowitz DR, Pajewski NM, Kazis LE. Intensive blood-pressure treatment and patient-reported outcomes. N Engl J Med 2017; 377: 2097.

39) Kodraliu G, Mosconi P, Groth N, Carmosino G, Perilli A, Gianicolo EA, Rossi C, Apolone G. Subjec-tive health status assessment: evaluation of the Italian version of the SF-12 Health Survey. Results from the MiOS Project. J Epidemiol Biostat 2001; 6: 305-316.

40) Schumacker RE, Lomax RG. A beginner's guide to structural equation modeling (3rd ed.). Routledge/Taylor & Francis Group, 2010.

41) Analyzing Data: Path Analysis. UCLA: Statistical Consulting Group. Available from: https://stats.idre.ucla.edu/mplus/seminars/intromplus-part2/analyzing-data-path-analysis.

42) Kim BI, Yoon SY, Kim JS, Woo KH, Cho SY, Lee H, An JM. Factors related with quality on sleep of daytime workers. Ann Occup Environ Med 2018; 30: 63.

43) Ghalichi L, Pournik O, Ghaffari M, Vingard E. Sleep quality among health care workers. Arch Iran Med 2013; 16: 100-103.

44) Madrid-Valero JJ, Martínez-Selva JM, Ribeiro do Couto B, Sánchez-Romera JF, Ordoñana JR. Age and gender effects on the prevalence of poor sleep quality in the adult population. Gac Sanit 2017; 31: 18-22.

45) Zeitlhofer J, Schmeiser-Rieder A, Tribl G, Rosenberger A, Bolitschek J, Kapfhammer G, Saletu B, Katschnig H, Holzinger B, Popovic R, Kunze M. Sleep and quality of life in the Austrian population. Acta Neurol Scand 2000; 102: 249-257.

46) Muscogiuri G, Barrea L, Aprano S, Framondi L, Di Matteo R, Laudisio D, Pugliese G, Savastano S, Colao A, on behalf of the OPERA PREVENTION Project. Sleep quality in obesity: does adherence to the Mediterranean Diet matter? Nutrients 2020; 12: 1364.

47) Fabbrini M, AricÃ I, Tramonti F, Condurso R, Carnicelli L, De Rosa A, Di Perri C, Bonsignore MR, Zito A, Russo G, Pagliarulo MG, Guarnieri B, Cerroni G, Mennuni G, Della Marca G, Bonanni E, Silvestri R. Sleep disorders in menopause: results from an Italian Multicentric Study. Arch Ital Biol 2015; 153: 204-213.

48) Garbarino S, Lanteri P, Durando P, Magnavita N, Sannita WG. Co-morbidity, mortality, quality of life and the healthcare/welfare/social costs of disordered sleep: a rapid review. Int J Environ Res Public Health 2016; 13: 831.

49) Sasawaki Y, Shiotani H. The influence of chronotype and working condition on sleep status and health related quality of life of daytime office workers. Kobe J Med Sci 2019; 64: E189-E196.

50) Yun JA, Ahn YS, Jeong KS, Joo EJ, Choi KS. The relationship between chronotype and sleep quality in Korean firefighters. Clin Psychopharmacol Neurosci 2015; 13: 201-208.

51) Juda M, Vetter C, Roenneberg T. Chronotype modulates sleep duration, sleep quality, and social jet lag in shift-workers. J Biol Rhythms 2013; 28: 141-151.

52) Taavoni S, Ekbatani NN, Haghani H. Postmenopausal women's quality of sleep and its related fac-tors. J Midlife Health 2015; 6: 21-25.

53) Otaka H, Murakami H, Nakayama H, Murabayashi M, Mizushiri S, Matsumura K, Tanabe J, Matsuhashi Y, Yanagimachi M, Yoshida K, Sugawara N, Yasui-Furukori N, Daimon M. Association between in-somnia and personality traits among Japanese patients with type 2 diabetes mellitus. J Diabetes Investig 2019; 10: 484-490.

54) Narisawa H, Komada Y, Miwa T, Shikuma J, Sakurai M, Odawara M, Inoue Y. Prevalence, symptomat-ic features, and factors associated with sleep disturbance/insomnia in Japanese patients with type-2 diabetes. Neuropsychiatr Dis Treat 2017; 13: 1873-1880.

55) Gao C, Chapagain NY, Scullin MK. Sleep duration and sleep quality in caregivers of patients with dementia: a systematic review and meta-analysis. JAMA Netw Open 2019; 2: e199891.

56) Intas G, Rokana V, Stergiannis P, Chalari E, Anagnostopoulos F. Burden and sleeping disorders of family caregivers of hemodialysis patients with chronic kidney disease-end stage: a cross-sectional study. Adv Exp Med Biol 2020; 1196: 33-40.

57) Rodríguez-Sánchez E, Pérez-Peñaranda A, Losada-Baltar A, Pérez-Arechaederra D, Á Gómez-Marcos M, Patino-Alonso MC, García-Ortiz L. Relationships between quality of life and family function in caregiver. BMC Fam Pract 2011; 12: 19.

58) Muzni K, Groeger JA, Dijk DK, Lazar AS. Self-reported sleep quality is more closely associated with mental and physical health than chronotype and sleep duration in young adults: a multi-instrument analysis. J Sleep Res 2020 Aug 11; e13152. doi: 10.1111/jsr.13152. Online ahead of print.

59) Barnes CM, Watson NF. Why healthy sleep is good for business. Sleep Med Rev 2019; 47: 112-118.