Ref: Ro J Neurol. 2024;23(2)
DOI: 10.37897/RJN.2024.2.8

Sleep quality in patients with Parkinson's disease in the Republic of Moldova – preliminary results

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ABSTRACT

Background and objectives. The rising prevalence of sleep issues are a consequent societal problem, notably impacting individuals with Parkinson's disease (PD). This study aims to examine the differences in sleep quality between diagnosed patients and their counterparts, while also highlighting its effects on their symptoms and quality of life.

Materials and methods. This study enrolled 37 PD subjects. Sleep quality, established via the Pittsburgh Sleep Quality Index (PSQI), was compared through a case control approach against 49 control subjects. PD symptomatology assessment was ensured via: Hoehn & Yahr (H&Y); Movement Disorder Society-Unified Parkinson's disease rating scale (MDS-UPDRS I-IV); Non-motor Symptom Scale (NMSS); Beck Depression Inventory (BDI); Montreal Cognitive Assessment (MoCA); Scale for Outcomes in Parkinson's disease – Psychosocial Functioning (SCOPA-PS); 39-Item Parkinson's Disease Questionnaire (PDQ-39).

Results. Compared to their homologues, PD subjects were prone to worse subjective sleep quality (18.9% vs. 8.2%), sleep efficiency (13.5% vs. 4.1%), diurnal functionality (27% vs. 12.2%), sleep related breathing disorders (62.2% vs. 46.9%). The global PSQI positively correlates to H&Y staging (rp= 0.443, p=0.008), UPDRS-III (rp= 0.369, p=0.029), UPDRS-IV (rp= 0.412, p=0.011). PD subjects with PSQI >5 registered higher UPDRS-III (p=0.091), BDI (p=0.928), SCOPA-PS (p=0.051). PSQI5 correlates to PDQ-39 (rp=0.423, p=0.010) and SCOPA-PS (rp= 0.462, p=0.004).

Conclusions. The study proved a clear correlation between altered sleep patterns and the clinical presentation of PD delineating the worsening of motor along to non-motor symptoms. In addition, the quality of life along to the psycho-social functioning of PD subjects is at risk in those manifesting sleep disturbances. Correspondingly, a greater interest should be applied in the establishment of prophylactic measures.

Keywords: Parkinson's disease, sleep quality, motor symptoms, non-motor symptoms

Abbreviations (in alphabetical order):

BDI	– Beck Depression Inventory
H&Y	– Hoehn & Yahr
MDS-UPDRS	– Movement Disorder Society-Unified Parkinson's disease Rating Scale
MoCA	– Montreal Cognitive Assessment
NMSS	– Non-motor Symptom Scale
PD	– Parkinson's disease
PDQ-39	– 39-Item Parkinson's Disease Questionnaire
SCOPA– PS	– Scale for Outcomes in Parkinson's disease – Psychosocial Functioning

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Article History:
Received: 4 June 2024
Accepted: 28 June 2024

INTRODUCTION

Parkinson's disease (PD) is the second most common neurodegenerative disorder [1] characterized by the loss of dopaminergic neurons in the substantia nigra compacta. It has acquired significant interest due to the aging population, particularly in developed regions. Previously thought to only manifest as extrapyramidal motor dysfunction, it is now understood to be a more complex condition involving a wide range of non-motor aspects such as sleep, neuropsychiatric, autonomic and sensory disorders.

The subject of sleep disorders has acquired increased interest as per the social and economic burden they impose. Several large-scale studies showed how deeply the public health care systems have been affected worldwide by this issue [2,3]; most commonly associated to the specifics of modern lifestyles, social features of the environments we live in and advances in technology subjecting us to more screen exposure time [4,5]. Additionally, in the time-frame of the eventful past years, crisis situations (the COVID-19 pandemic, war and political instability, natural disaster) showed to drastically alter sleep in the general population [5,6].

Recent studies in molecular research have discovered connections between the development and advancement of synucleinopathies like PD, and sleep patterns specifically by creating a favorable milieu for the builtup of pathologic proteins and neuroinflammation. Consequently, disrupted sleep schedules increase the generation of misfolded proteins, leading to their buildup in the interstitial space and in the glymphatic system which encourages aggregate formation [7–9]. The presence of protein waste triggers reactive gliosis and an inflammatory reaction that is amplified under conditions with decreased antioxidant defenses due to the dampened melatonin production [8,10].

From a clinical perspective, PD prodrome is strongly linked to changes in brain structures resulting in REM sleep behavior disorder (RBD) that could also be perceived as an early indicator of synucleinopathy. Studies show that 44% of patients develop Parkinson's disease after a mean follow-up of 4.75 ± 2.43 years; and 80 - 90% of them developing a neurodegenerative disorder 14 years later [11–14]. As the condition progresses, sleep regulatory structure's involvement accentuates leading to further alterations in sleep patterns contributing to the advancement of neurodegeneration.

The aforementioned advancements in understanding the underlying sleep disruption mechanisms associated to PD lead to a duplication of researches worldwide evaluating the weight they produce on the clinical presentation of the condition. However, this domain is relatively new in the Republic of Moldova where sleep medicine per se is a new field of interest. Thus, through this preliminary study we aim to identify how variations in sleep quality parameters reflects upon the symptomatology of PD in the Republic of Moldova, by identifying the impact on the motor and non-motor symptoms along to the degree in alteration of the quality of life.

MATERIALS AND METHODS

Clinical evaluation

An exhaustive evaluation of the subjects was performed encompassing demographic data, disease staging (Hoehn & Yahr scale), Levodopa Equivalent Daily Dosage (LEDD), along with clinical assessment. Upon the granted permission of use of the International Parkinson's Disease and Movement Disorder Society, several scales were employed to evaluate symptoms:

- The Movement Disorder Society Unified Parkinson's Disease Rating Scale (MDS - UPDRS) parts I-IV for the evaluation of the degree of motor dysfunction;
- The Non-Motor Symptom Scale (NMSS) for the assessment of the severity and frequency of the non-motor symptoms (cardiovascular, sleep/fatigue, mood/cognition, perceptual problems/hallucinations, attention/memory, gastrointestinal tract, urinary, sexual function, miscellaneous);
- The Scale for Outcomes in Parkinson's disease – Psychosocial Functioning (SCOPA – PS) in order to illustrate the overall psychosocial functioning of the individual.

Complementary questionnaires used to evaluate the degree of depression and cognition were: the Beck Depression Index (BDI) and the Montreal Cognitive Assessment (MoCA) analysis (visuospatial/executive skills, memory, attention, language, abstraction, memory and orientation). The overall quality of life during the past month in PD subjects was evaluated via the 39-Item Parkinson's Disease Questionnaire (PDQ-39) depicting the degree of impairment of mobility, activities of daily living, emotional well-being, stigma, social support, cognition, communication and bodily discomfort.

Sample characteristics

This study presents a cross-sectional analysis of sleep characteristics in Parkinson's disease patients conducted at the "Diomid Gherman" Institute of Neurology and Neurosurgery in Chisinau, Republic of Moldova, from 2020 to 2023.

The study involves a preliminary assessment of a smaller group comprising 37 PD patients (men: 40.5% (n=15); women: 59.5% (n=22)) with an average age of 59.97 ± 8.50 years, selected from a larger pool of individuals who did not meet the eligibility criteria re-

TABLE 1. Cohort characteristics

Characteristics	PD sample (n=37)	Control sample (n=49)	Global cohort (n=86)
Age (years) (mean, ±SD)	59.97, ±8.50	61.33, ±15.28	60.74, ±12.73
Gender			
Males	40.5% (n = 15)	44.9% (n = 22)	43% (n = 37)
Females	59.5% (n = 22)	55.1% (n = 27)	57% (n = 49)
Sleep quality			
Global PSQI (mean, ±SD)	6.757, ±4.212	8.143, ±3.403	7.546, ±3.812
PD stage			
Hoehn & Yahr (mean, ±SD)	2.071, ± 0.423	-	-
MDS-UPDRS III (mean, ±SD)	15,60, ± 9.876	-	-
LEDD (mean, ±SD)	641.946, ±327.918	-	-

PSQI, Pittsburgh Sleep Quality Index; LEDD, levodopa equivalent dose; MDS-UPDRS III, Movement Disorder Society – Unified Parkinson's Disease Rating Scale; SD, Standard Deviation

quiring a confirmed diagnosis of Parkinson's disease and excluding those with notable neurological and systemic comorbidities, as well as individuals with Parkinson plus syndromes or other neurodegenerative conditions.

Complementary, a control sample group of 49 subjects (44.9% males (n=22) and 55.1% females (n=27)) with an average age of 61.33±15.28 years was selected to compare the sleep quality differences between PD and non-PD individuals using a case-control approach. Inclusion criteria required the absence of any parkinsonian syndromes or major neurological disorders.

Sleep quality evaluation

The Pittsburgh Sleep Quality Index (PSQI) was used - a self-administered questionnaire portraying the quality of sleep throughout the past month by depicting the degree of disruption of seven components: subjective sleep quality (PSQI 1), sleep latency (PSQI 2), sleep duration (PSQI 3), habitual sleep efficiency (PSQI 4), sleep disturbances (PSQI5), use of sleep medication (PSQI 6), daytime dysfunction (PSQI 7). Therefore, to assess the impact of sleep quality on both motor and non-motor symptoms, two subgroups were created for analysis based on their Pittsburgh Sleep Quality Index scores: PSQI <5 points – representing good sleepers (n=17), and PSQI >5 points – indicating poor sleepers (n=20).

Statistical evaluation

The statistical assessment of the collected data was ensured via Epi Info™, several analysis methods being used in conformity to the data types. Descriptive statistics were employed to contour the traits of the samples including demographic specifics, along to variances in obtained scores and responses to the questionnaires. Inferential statistics were ensured by the independent student's t-test for the interpretation of scores (PSQI, SCOPA-PS, BDI, MoCA, NMSS, MDS-UPDRS I-IV, PDQ-39) and the chi-square test for all of the categorial values. The association of various sleep components to the evaluated clinical traits of Parkinson's disease was established through the Pearson correlation test. The first step in the analysis was the evaluation of differences in sleep quality among PD and control subjects, with subsequent identification of the types of sleep dysfunctions prevailing each group. The second step was the assessment of correlations between sleep quality parameters and PD symptomatology, followed by a secondary analysis of those symptoms in perspective to the preserved or altered sleep quality.

RESULTS

Cohort general characteristics

The study included 86 subjects divided into the PD and control sample group characterized by approximately similar mean ages (59.97 ±8.50 vs. 61.33 ±15,28, p=0,628) and gender distributions (40.5% males and 59.5% females in the PD group, 44.9% males and 55.1% females in the control group).

The overall functional disability in subjects with PD corresponded to Hoehn and Yahr stage II-III, with a mean score of 2.071 (± 0.423). Mild motor impairment was observed based on the MDS-UPDRS III score (15.60 ± 9.876) whilst subjects administered a baseline antiparkinsonian treatment, with an average LEDD (levodopa equivalent daily dose) of 641.946 (±327.918) (Table 1).

Sleep quality in Parkinson's disease vs. control group

The comparative analysis between the samples showed accentuated alterations in sleep quality in the control subjects (6.757, ±4.212 vs. 8.143, ±3.403, p <0.001) (Table 4). A majority (63.3%) affirmed using sleep medication during the previous month, in addition to having a history of night shift work (36.7%). In subjects diagnosed with Parkinson's disease, sev-

TABLE 2. Correlations between sleep quality parameters and symptoms of Parkinson's disease

Pearson correlations (r_p)	PSQI1	PSQI2	PSQI3	PSQI4	PSQI5	PSQI6	PSQI7	Total PSQI
Hoehn & Yahr	**0.382** **p=0.024**	0.292 p=0.089	**0.334** **p=0.050**	**0.502** **p=0.002**	0.241 p=0.163	0.128 p=0.464	0.281 p=0.102	**0.443** **p=0.008**
LEDD	0.161 p=0.340	0.081 p=0.633	0.162 p=0.338	0.295 p=0.077	0.252 p=0.133	-0.058 p=0.735	0.100 p=0.555	0.156 p=0.356
Motor symptoms								
UPDRS I	0.279 p=0.094	**0.410** **p=0.012**	-0.049 p=0.775	0.178 p=0.292	**0.412** **p=0.011**	0.180 p=0.285	0.249 p=0.285	0.284 p=0.089
UPDRS II	0.276 p=0.099	0.280 p=0.094	0.087 p=0.610	0.087 p=0.908	**0.556** **P<0.001**	0.139 p=0.413	0.241 p=0.150	0.260 p=0.120
UPDRS III	**0.384** **p=0.023**	0.123 p=0.482	**0.428** **p=0.010**	**0.395** **p=0.019**	0.274 p=0.112	-0.030 p=0.862	0.134 p=0.442	**0.369** **p=0.029**
UPDRS IV	**0.403** **p=0.013**	0.198 p=0.240	0.286 p=0.086	**0.426** **p=0.009**	**0.378** **p=0.021**	0.187 p=0.268	0.222 p=0.187	**0.412** **p=0.011**
Non-motor symptoms								
NMSS	0.255 p=0.140	**0.518** **p=0.001**	0.061 p=0.726	-0.025 p=0.888	**0.339** **p=0.047**	0.059 p=0.735	0.182 p=0.295	0.234 p=0.176
SCOPA – PS	0.236 p=0.160	**0.443** **p=0.006**	0.102 p=0.547	0.124 p=0.464	**0.462** **p=0.004**	0.015 p=0.928	0.113 p=0.507	0.244 p=0.146
MoCA	-0.151 p=0.373	-0.130 p=0.442	-0.100 p=0.555	-0.180 p=0.285	-0.312 p=0.060	-0.115 p=0.498	-0.035 p=0.835	-0.160 p=0.344
BDI	0.114 p=0.500	0.250 p=0.136	-0.028 p=0.869	-0.125 p=0.462	**0.537** **p=0.001**	-0.132 p=0.437	0.290 p=0.082	0.088 p=0.606
PDQ – 39	0.207 p=0.225	0.298 p=0.077	0.168 p=0.327	0.097 p=0.575	**0.423** **p=0.010**	-0.045 p=0.796	0.249 p=0.144	0.287 p=0.089

PSQI, Pittsburgh Sleep Quality Index;LEDD, LevoDopa Equivalent Dose; MDS-UPDRS I-IV, Movement Disorder Society – Unified Parkinson's Disease Rating Scale; MoCA, Montreal Cognitive Assessment; SCOPA-PS, Scales for Outcomes in Parkinson's Disease – Psychosocial Functioning; PDQ-39, Parkinson's Disease Questionnaire; NMSS, Non-motor Symptom Scale: BDI, Beck Depression Index. PSQI, Pittsburgh Sleep Quality Index; PSQI1, Subjective sleep quality; PSQI2, Sleep Latency; PSQI3, Sleep duration; PSQI4, Sleep efficiency; PSQI5, Sleep disturbances; PSQI6, Usage of sleep medication; PSQI7, Daytime dysfunction

TABLE 3. Sleep dysfunctions in Parkinson's disease vs. control subjects

	Parkinson's disease subjects		Control subjects	
Subgroups based on their answers („yes" or „no")	Yes	No	Yes	No
Usage of sleep medication χ^2 = 12.850, df=1, p<0.001	24.3% (n=9)	75.7% (n=28)	63.3% (n=31)	36.7% (n=18)
History of work in night shift χ^2 = 5.802, df=1, p=0.016	13.5% (n=5)	86.5% (n=32)	36.7% (n=18)	63.3%(n=31)
Presence of sleep dysfunctions:				
Subjective sleep quality χ^2 =2.186, df=1, p=0.139	18.9% (n=7)	81.1% (n=30)	8.2% (n=4)	91.8% (n=45)
Sleep efficiency χ^2 =2.508, df=1, p=0.113	13.5% (n=5)	86.5% (n=32)	4.1% (n=2)	95.9% (n=47)
Diurnal functionality χ^2 =3.042, df=1, p=0.081	27.0% (n=10)	73.0% (n=27)	12.2% (n=6)	87.8%(n=43)
Troubles initiating sleep χ^2 =8.057, df=1, p=0.005	43.2% (n=16)	56.8% (n=21)	73.5% (n=36)	26.5% (n=13)
Nocturnal awakenings χ^2 =3.359, df=1, p=0.067	81.1% (n=30)	18.9% (n=7)	93.9% (n=46)	6.1% (n=3)
Disordered breathing in sleep χ^2 =1.964, df=1, p=0.161	62.2% (n=23)	37.8% (n=14)	46.9% (n=23)	53.1% (n=26)
Nightmares χ^2 =2.519, df=1, p=0.112	37.8% (n=14)	62.2% (23)	55.1% (n=27)	44.9% (n=22)

eral sleep disturbances prevailed such as diminished subjective sleep quality (18.9% vs. 8.2%), sleep efficiency (13.5% vs. 4.1%), diurnal functionality (27% vs. 12.2%) and more pronounced sleep related breathing disorders (62.2% vs. 46.9%) (Table 3).

Sleep quality impact on motor and non-motor symptoms in Parkinson's disease

The analysis provided several findings regarding the relationship between sleep quality and the clinical manifestations in Parkinson's disease. The

TABLE 4. Sleep quality in Parkinson's disease vs. control subjects

Characteristics	PD sample group				Control sample group				
	Good sleep quality	*Bad sleep quality*			*Good sleep quality*	*Bad sleep quality*			
Subgroups based on PSQI global score Sleep components	**PSQI ≤ 5 (n = 17)**	**PSQI > 5 (n = 20)**		**Global PSQI**	**PSQI ≤ 5 (n = 13)**	**PSQI > 5 (n = 36)**		**Global PSQI**	
PSQI1	0.588, ±0.507	1.500, ±0.688	*p<0.001*	**1.081, ±0.759**	0.750, ±0.622	1.486, ±0.562	*p=0.002*	**1.298, ±0.657**	***p<0.001***
PSQI2	0.294, ±0.470	1.600, ±1.231	*p<0.001*	**1.000, ±1.155**	0.850, ±0.801	1.810, ±0.668	*p=0.001*	**1.551, ±0.818**	***p<0.001***
PSQI3	0.294, ±0.470	1.600, ±1.231	*p<0.001*	**0.946, ±0.970**	0.167, ±0.389	0.639, ±0.798	*p=0.010*	**0.521, ±0.743**	***p=0.001***
PSQI4	0.118, ±0.332	1.500, ±1.051	*p<0.001*	**0.865, ±1.058**	0.333, ±0.492	1.139, ±0.990	*p=0.001*	**0.938, ±0.954**	***p<0.001***
PSQI5	1.118, ±0.600	1.550, ±0.510	*p=0.026*	**1.351, ±0.588**	0.923, ±0.494	1.556, ±0.504	*p=0.001*	**1.388, ±0.571**	***p=0.010***
PSQI6	0.294, ±0.772	0.700, ±1.261	*p=0.239*	**0.513, ±1.070**	0.333, ±0.651	1.778, ±0.989	*p<0.001*	**1.417, ±1.108**	***p=0.001***
PSQI7	0.588, ±0.507	0.950, ±1.050	*p=0.183*	**0.784, ±0.854**	0.833, ±0.577	1.222, ±0.591	*p=0.059*	**1.125, ±0.606**	***p=0.015***
Total PSQI	3.235, ±1.091	9.750, ±3.477	*p<0.001*	**6.757, ±4.212**	4.000, ±0.155	9.639, ±2.598	*p<0.001*	**8.143, ±3.403**	***p<0.001***
Sleep duration (hours)	6.985, ±0.731	5.750, ±1.209	*p=0.001*	**6.318, ±1.182**	7.125, ±0.678	8.563, ±11.467	*p=0.459*	**9.921, ±1.432**	***p=0.623***
Sleep latency (minutes)	19.352, ±41.845	46.275, ±51.936	*p=0.090*	**33.905, ±48.855**	17.846, ±9.371	40.139, ±37.081	*p=0.002*	**34.225, ±33.518**	***p=0.056***

PSQI, Pittsburgh Sleep Quality Index; PSQ1, Subjective Sleep Quality Index; PSQI2, Sleep Latency; PSQI3, Sleep duration; PSQI4, Sleep efficiency; PSQI5, Sleep disturbances; PSQI6, Usage of sleep medication; PSQI7, Daytime dysfunction

mean PSQI score in the studied subjects differ greatly among the samples (3.235, ± 1.091 vs. 9.750, ±3.477, p<0.001) (Table 4). Longer sleep duration was registered in the sub-group with preserved sleep quality (6.985, ±0.731 vs. 5.731, ±1.209, p=0.001) along to shorter sleep latency (19.352, ±41.845 vs. 46.275, ±51.936, p=0.090) (Table 4).

Data showed higher LEDD in subjects with PSQI < 5 (672.059, ±344.750 vs. 616.35, ±319.616, p=0.616), suggesting that patients with better sleep quality were receiving higher doses of levodopa equivalent medication. Furthermore, there was a moderate positive association between disease staging evaluated by Hoehn & Yahr and the global PSQI score (r_p= 0.443, p=0.008).

The Pearson correlation test also illustrated moderate correlations between the sleep quality and motor symptoms such as: UPDRS-III (r_p= 0.369, p=0.029) and UPDRS-IV (r_p= 0.412, p=0.011); which is sustained by similar results regarding multiple of the constituents of PSQI. The overall UPDRS scores were higher in subjects with altered sleep (UPDRSIII – 32.76, ±13.890 vs. 39.72, ±8.917, p=0.091). Regarding the non-motor symptoms, strong and moderate correlations were seen among NMSS and several components of sleep: PSQI (r_p=0.518, p=0.001) or PSQI5 (r_p= 0.339, p=0.047). Both samples noted mild depressive symptoms, with a greater degree observed in those with PSQI>5 (11.76, ±9.477 vs. 12.05, ±9.473, p=0.928) (Table 2,4).

The degree of life quality in subjects with Parkinson's disease presented a modest link without statistical significance (PDQ-39 vs. global PSQI: r_p=0.287, p=0.089), however a moderate association could be observed with one of the sleep components (PDQ-39 vs. PSQI 5 r_p=0.423, p=0.010). From a psycho-social perspective, a correlation was found with sleep latency and the presence of sleep disturbances (SCOPA-PS vs: PSQI2 (r_p=0.443, p=0.006); PSQI5 (r_p=0.462, p= 0.004)). In addition, subjects with higher PSQI had worst SCOPA-PS scores (6.00, ±5.136, vs. 10.10, ±7.166, p=0.051) (Table 2, 4).

DISCUSSION

Sleep quality in Parkinson's disease subjects compared to general population

The characteristics of sleep-wake cycles bear great importance in the various stages of Parkinson's or any neurodegenerative disorders' evolution. Their disruption was shown to create the adequate milieu for the instigation and progression of the pathology. In addition, as the neurodegenerative modifications advance, so does the involvement of brain structures ensuring the homeostasis and regulation of sleep patterns [15,16].

Hence, the study conducted was built upon the hypothesis that the sleep quality would be more altered

TABLE 5. Variations in symptoms in Parkinson's disease in good or altered sleep quality

Characteristics	PD sample		
PSQI score	**PSQI ≤ 5 (n=17)**	**PSQI > 5 (n=20)**	
Demographic characteristics			
Age	59.71, ±8.153	60.20 ±8.983	***p =0.862***
Hoeh & Yahr score	1.882, ±0.332	2.250, ±0.429	***p =0.008***
LEDD	672.059, ±344.750	616.35, ±319.616	***p =0.616***
Motor symptoms			
MDS-UPDRS I	7.35, ±4.987	10.25, ±5.505	***p =0.102***
MDS-UPDRS II	9.24, ±8.664	11.50, ±7.273	***p =0.400***
MDS-UPDRS III	32.76, ±13.890	39.72, ±8.917	***p =0.091***
MDS-UPDRS IV	1.24, ±2.948	2.35, ±4.356	***p =0.363***
Non-motor symptoms			
MoCA	23.41, ±2.785	23.20, ±2.093	***p =0.798***
SCOPA-PS	6.00, ±5.136	10.10, ±7.166	***p =0.051***
PDQ-39	47.82, ±28.712	59.68, ±20.745	***p =0.170***
BDI	11.76, ±9.477	12.05, ±9.473	***p =0.928***
NMSS	43.88, ±32.482	51.89, ±41.565	***p =0.529***

PSQI, Pittsburgh Sleep Quality Index; BMI, Body Mass Index; LEDD, LevoDopa Equivalent Dose; MDS-UPDRS I- IV, Movement Disorder Society – Unified Parkinson's Disease Rating Scale; MoCA, Montreal Cognitive Assessment; SCOPA-PS, Scales for Outcomes in Parkinson's Disease – Psychosocial Functioning; PDQ-39, Parkinson's Disease Questionnaire; NMSS, Non-motor Symptom Scale: BDI, Beck Depression Index

in PD subjects compared to controls, a fact which was disproved in our analysis since the PSQI scores were fairly higher in the latter sample (6.757, ± 4.212 vs. 8.143, ±3.403, p<0.001). This outcome contradicts that of studies with larger samples and meta-analyses that distinguish up to 63% of patients presenting sleep disorders, making those the most common non-motor symptoms registered, encompassing a wide array of pathological entities such as: insomnia, excessive day-time sleepiness, REM (rapid eye movement) sleep behavior disorder and disrupted breathing patterns in sleep [15,17]. This latter element proved to also prevail in the analyzed PD individuals compared to controls (62.2%). The overall PSQI components evaluated in this research noted a greater degree of deterioration in control subjects. However, from a purely descriptive stand point, it was observed that the duration of sleep in PD subjects was lower (6.318, ±1.182 vs. 9.921, ±1.403, p=0.623). This type of reduction is commonly seen as individual ages, but was proven to be more accentuated in those with Parkinson's, a fact which is supported by polysomnographic studies that also point out greater sleep latencies, fragmentation and reduction of the overall efficiency [16–18].

Limitations in our study and discrepancies between the results obtained and other similar studies can be attributed to the small sample sizes, along to several other elements that can impact one's steadiness of sleep-wake cycles. For instance, most of control subjects stated to have worked nightshifts compared to subjects with PD (36.7% vs. 13.5% (χ^2=5.802, df=1, p=0.016)). The results thus portray a rather controversial action of disrupted sleep patterns and circadian clocks on the genesis of PD – several studies showing no association [19,20], in contrast with others which underlined an impact upon the development of the disease [21,22]. Complementary, a deeper research on the demographic peculiarities of the control group would be needed to establish if underlying neurological or somatic conditions were not negatively impacting sleep patterns in those subjects. In addition, further investigation of circadian and environmental sleep-wake cycle modifiers should be evaluated as per their ability to shape the entire sleep pattern [9,23–25].

Motor symptoms in Parkinson's disease based on the quality of sleep

When considering Parkinson's disease, the primary features that come to mind are the distinct motor symptoms such as bradykinesia, rest tremor, rigidity, and hypokinesia. This study made several observations regarding their correlation with sleep quality.

Hence, the analysis of the motor function of the studied sample proved a positive moderate correlation between UPDRS III and PSQI scores (r_p= 0.369, p=0.029). This result is supported by data obtained in a similarly structured study (PSQI vs. UPDRSII-III, p<0.001) [26]. However, the deterioration/improvement of which of the variables is of main interest is imprecise. Research on the subjects point out the bidirectionality among those two entities - increased motor deficits are linked to higher rates of a variety of sleep disorders and vice-versa. Subsequently, correlations were found between the various elements defining insomnia based on the International Classification of Sleep Disorders (ICSD) -3 – notably: sleep initiation, maintenance or early awakenings; and oscillations in motor function in PD subjects [27–29]. Other researches pointed out the association between restless limb syndrome and higher UPDRS III scores, also reflected in those with advanced Hoehn & Yahr stages [30,31]. A possible explanation linking those two entities would be the progressive implica-

tion of dopaminergic structures accounting for the pathophysiology of both conditions. Multiple studies concentrate on parasomnias in Parkinson's, with particular accent on REM sleep behavior disorder (RBD), proving its prodromal nature and utility as a tool in assessing one's susceptibility to develop the disease up to 10 years before its onset [27,32–34]. Based on Braak's theory, this phenomenon could be explained by the early involvement of sleep regulatory structures in the pons and medulla responsible for inhibition of movement enactment during sleep before the synucleopathy spreads to mesencephalic structures. A non-negligible element is that the condition persists after photoconversion of PD and can further more accentuate movement deficits.

Other motor nuisances in PD that compromise one's sleep efficiency is impaired bed mobility. Patients suffer from reduced capacity at executing nocturnal movements such as turning or changing posture in bed, the following being associated to more advanced disease stages [35]. Several longitudinal studies contoured their prodromal nature for those disturbances which can manifest years before the onset of PD [32,35]. In addition, discomfort and pain produced by the impairment furthermore accentuates excessive day-time sleepiness and the degradation of quality of life [35].

Non-motor symptoms in Parkinson's disease based on the quality of sleep

The non-motor symptom scale, which sums up the repercussions of a wide array of psycho-somatic clinical manifestations found in PD, was particularly useful in evaluating the weight those have on Parkinson's disease proving the positive correlations with sleep latency (p=0.001) and sleep disturbances (p=0.047). In addition, subjects with altered sleep had poorer NMSS scores (p=0.529), this result being supported by a similar study conducted on a larger samples (p<0.001) [26].

The analysis showed only a slight difference between cognitive functions among the sub-groups (p=0.798). A study on people at risk in developing Parkinson's showed more accentuated cognitive impairment in individuals diagnosed with RBD via polysomnography than the rest of the samples (p<0.001) [36]. Complementary, the assessment of the depression degree in those with altered sleep patterns established worse BDI scores (p=0.981). Although, the association obtained is inconclusive, other researchers found that PD subjects presenting sleep disruptions such as insomnia, EDS or limb restlessness syndrome were more depressed and anxious than controls [15].

All of those results support the idea that chronic sleep disorders enhance neurodegenerative modifications affecting various brain areas involved in the regulation of somatic along to cognitive-behavioral functions. The accumulation of modified proteins, especially alpha-synucleins, is enhanced in sleep deprivation by compromising their elimination pathways: the glymphatic systems or endo-/phagocytosis. In addition, they contribute to microgliosis, accumulation of reactive species of oxygen and reduction in protective mechanisms [9].

Quality of life in Parkinson's disease based on quality of sleep

Health related quality of life in PD subjects with increased PSQI scores was diminished, presenting higher PDQ-39 scores in contrast to their counterparts (48.82, ±28.712 vs. 59.68, ±20.745, p =0.170). Although the obtained results lack statistical significance, a similar study supports this statement: a study conducted between 2011-2013 at the University of Miami Movement Disorder Clinic on 66 individuals with mild to moderate PD showed those diagnosed with insomnia were more affected in their day-to-day life by the disease (26.7, ±15.4 vs. 176, ±11.1, p<0.001)[37]. The evaluation of psycho-social functioning in patients with Parkinson's disease noted the presence of a correlation with the presence of sleep disturbances (p=0.004) and greater alterations were found in those with high PSQI (p=0.051).

Correspondingly, as the epidemiological data portray, the increase in life expectancy extends the YLDs of those patients causing great burden upon societies. As countries develop, in the context of this study – those in eastern European regions such as the Republic of Moldova, the need of prophylactic strategies is required. Thus, improving sleep quality in PD and non-PD populations represents an effective and cost-efficient preventive measure that needs to be encompassed into a national wide program.

CONCLUSION

One of the main purposes of this research was to establish how sleep quality varies in patients diagnosed with Parkinson's disease compared to their equals. Based on the gathered results, PD subjects, despite of a more accentuated reduction in sleep duration – characteristic to neurodegenerative processes, had less altered sleep patterns. The result contradicts those of previous studies, but further analysis of modifying factors could shed light on this discrepancy. However, subjective sleep quality (18.9%), sleep efficiency (13.5%), diurnal functionality (27%) and sleep related breathing disorders (62.2%) prevailed in diagnosed individuals.

Subsequent analysis of symptoms in PD, showed positive dynamics when exposed to steady sleep patterns, correlations being noticed in regards to motor and non-motor dysfunctions. Thus, disorders such as

insomnia, RLS, and RBS favor the ongoing neurodegenerative modifications related to the pathophysiology of PD whilst altering various brain structures responsible for the wide array of clinical manifestations.

Finally, the research objectified, in concordance to similar studies, the marked decrease in life quality in those diagnosed along to altered psycho-social functioning. Such information should raise warning signs in the context of an aging population and increase in years lived with the disease, especially for the socio-economic burden it imposes on the health care systems, especially in developing countries such as the Republic of Moldova. Correspondingly, measures of prophylaxis should be emphasized at younger ages in the frame of the prodromal debut of PD and should be continued even after photoconversion to slow the progression and severity of symptoms.

Conflict of interest: The authors certify to not have any financial or personal relationships that might bias the content of this work.

Acknowledgements: The research took part of the post-doctoral program 23.00208.8007.01/PD II.

Author's contributions: The following individual contributions to this research and article were made:
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- Funding acquisition: L. Rotaru, S. Groppa, V. Vovc.

All authors have read and agreed to the published version of the manuscript.

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