Sleep Characteristics and State of Well - Being in Patients Undergoing Cataract Surgery in Timisoara, Romania

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Our study aimed to investigate sleep characteristics and the state of well-being connected to presurgical and evolutive eye pathology, between pre- and postsurgical assessments, in the context of clinical benefits of prosthetic lens replacement in patients who adressed the Clinic of Ophthalmology in Timisoara in 2015. The study group included 53 patients diagnosed with cataract, 49.1% men, with the mean age for the entire group 70.1±8.3 years. The work methods consisted in conducting a transversal populational study involving presurgical and postsurgical use of the WHO Questionnaire for the 5 criteria of the sate of well-being (WHO-5); the investigation of sleep duration and qualitatuive perception; testing for the visual acuity (VA); phacoemulsification for lens replacement. After processing invividual data the following results were obtained: The assessment one month after cataract surgery shows a significant increase of sleep duration and quality and a significant improvement of the WHO-5 index, with no patients reporting sleep duration under 5 hours or a WHO-5 index under 13 points which would represent a threshold indicative for the diagnosis of depression. The addressability to cataract surgery in Romania and the benefits of early surgical treatment are discussed.

Keywords: sleep duration, state of well-being, cataract patients

The rhythm of population aging dramatically increased during recent years and it is expected that the population aged over 60 to double, from 12% to 22%, between 2015 and 2050.

Increased life span brings additional oportunities not only for the elderly and their families but also for the society. Elderly persons may cotribute in many ways in their families and communities but the extent of such oportunities and contributions highly depends upon one factor: health [WHO 2012].

Although most cataract cases are linked to the process of aging, sometimes this pathology may be present in newborns, may develop after ocular lesions, inflammation and other ocular diseases. According to the most recent WHO assessment, cataract is responsible fro 51% of cecity cases worldwide, which represent around 20 million persons [WHO 2013].

At present, WHO considers that in adults aged over 60, in high income countries, cataract causes 136 YLD (years lost due to disabilities) / 100,000 inhabitants, and 1478 YLD / 100,000 inhabitants worldwide [WHO 2012].

Most studies assessing the results of cataract surgery focused on visual acuity and refraction status. Cataract surgery offers significant improvements in objective measurements and subjective improvements of visual functionality and life quality [McAlinden, Gothwal, Khadka J, 2011].

In our study we aimed to investigate sleep characteristics and the WHO-5 score of well-being evaluated before cataract surgery and in evolution, between the presurgical and postsurgical assessments, in the context of clinical benefits of lens prosthetic replacement in patients who addressed the Clinic of Ophthalmology in Timisoara in 2015.

Experimental part

Material and method

The study included 53 cataract patients who addressed the Clinic of Opthalmology in Timisoara between January and April 2015. Of these patients, 49.1% are men, the mean age of the entire group being 70.1±8.3 years. There were no significant mean age differences between the two genders, p=0.206. The groups are homogeneous age- and genderwise.

Before surgery, for the eye with the best results we found 69.8% of patients with no visual defects or with minor deficiencies, 20.8% with moderate visual defects and 9.4% with severe defects or with cecity. For the eye with the worst results we found 20.8% of patients with no defects or with minor deficiencies, 24.5% with moderate defects and 54.7% with severe defects or with cecity. One month after surgery, the visual acuity was classified as „no visual deficit" in all patients, the maximum VA value being reached by 83% of the group, and equal percents of 5.7% had values of visual acuity for the operated eye of 0.6, 0.7 and 0.9, respectively.

Methods applied pre- and post-surgery:

-The transversal populational study used the *WHO questionnaire for 5 well-being criteria, WHO5,* which was developed by the Unit for Psychiatric Research, Hillerød Denmark, WHO affiliated mental health centre [The WHO-5 website]. The WHO5 questionnaire was validated in a series of studies regarding clinical and psychometric validity [Allgaier, Kramer, Saravo 2013; Topp, Ostergaard, Sondergaard, Bech, 2015]. It is freely available in multiple languages, including Romanian [The WHO-5 website]. The questionnaire includes 5 elements evaluated against the Likert 6 points scale and it monitors the subjective quality of life based upon a positive state of mind (good feelings, relaxation), vitality (active, fresh and well rested upon

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awakening) and general interest (the state of being interested in the surrounding reality). Higher scores indicate higher well-being levels. Patients with scores lower than 13 should be tested for the clinical diagnosis of depression (ICD-10). For monitoring purposes, a score change with more than 10% is considered significant [The WHO-5 website].

-Patients were questioned regarding the number of hours of sleep during the week and in weekends. In order to assess the quality of sleep we used a Likert 6 points scale.

-Tests for corrected and uncorrected visual acuity (VA) used the Snellen chart and an autorefractometer.

Phacoemulsification was the surgical intervention used for lens replacement.

Data processing and interpretation involved modern advanced medical statistics. Data were electronically filed using Microsoft Excel, version 2007 and processed with PASW 18 (SPSS 18) 2010. The threshold for statistuical significance was set at $p<0.05$. We applied correlations of ordinal data by the Kendall test and for the comparison of ordinal data we used the Mann-Whitney and Kruskal-Wallis tests. For pre-/post-surgery comparisons we used the mixed variance analysis.

Results and discussions

Sleep duration and quality

Presurgically

The average number of sleeping hours during the week is 5.04 ±1.27 with variations between 2 and 8 h, and for weekend nights an average of 5.40 ±1.35 h was reported with variations between between 2 and 8 h. For week nights 39.6% (21) of the group declare less than 5 h of sleep, and for weekend nights the percent is 26.4% (14).

In the assessment regarding the number of sleeping hours during the night which they require to avoid fatigue, we found that patients would need an average of 8.03 ±0.682 h, with an interval between 6 and 10 h per night.

We did not find any relation between the degree of visual deficiency and the average number of sleeping hours during the week ($p=0.890$), during the weekend ($p=1.000$), or the estimated number of hours required to rest ($p=0.547$).

Regarding the quality of sleep, 62.3% (33) describe it as poor and very poor. Sleep quality correlates with the number of sleeping hours during the week $\tau=0.546$, $p<0.001$, $r=0.29$, and with the number of hours slept during the weekend $\tau=0.609$, $p<0.001$, $r=0.37$, the magnitude of association being low to medium for week days and medium for weekends.

The perception on sleep quality does not differ with the degree of presurgical visual deficiency, $p<0.05$.

Postsurgically

Patients responded that the average number of sleeping hours during the week is 6.83 ±0.612, from a minimum of 5 to a maximum of 8 h , and for weekend nights an average of 7.04 ±0.619 h was reported, between a minimum of 5 and a maximum of 8 h.

Regarding the assessed number of sleeping hours to avoid fatigue, we found that patients would need an average of 8.08 ±0.602 h, with an interval between 6 and 10 h per night. When compared to the presurgical status, this assessment does not differ statistically, $p=0.180$. When questioned on the quality of sleep, 77.3% (41) describe it as good and very good.

A mixed between-within subject analysis of variance was conducted to assess the impact of initial categories of VA deficit on participants mean hours slept per hight during week, evaluated pre- and post-surgery. We did not find any significant interaction between the evolution in time regarding the number of sleeping hours during the week depending on VA deficit categories, Wilks Lambda=0.899, $F(2.50)=2.79$, $p=0.071$, but we did find that the pre-/postsurgical evolution of the number of sleeping hours during the week is statistically significant, Wilks Lambda=0.256, $F(1,50)=145.31$, $p<0.001$, partial eta squared =0.744, witch represents a large size effect.

A mixed between-within subject analysis of variance was conducted to assess the impact of initial categories of VA deficit on participants mean hours slept per hight during week-end, evaluated pre- and post-surgery. We did not find any significant interaction between the evolution of the number of sleeping hours during weekends depending on VA deficit categories, Wilks Lambda=0.916, $F(2.50)=2.27$, $p=0.113$, but we found that the pre-/postsurgical evolution of the number of sleeping hours/night during weekends is statistically significant, Wilks Lambda=0.362, $F(1.50)=88.29$, $p<0.001$, partial eta squared =0.638, representing a large size effect (fig. 2).

A significant improvement in the self-perception of sleep quality may be observed between the pre- and post-surgery situations, respectively, $z=-5.87$, $p<0.001$, $r=0.80$, the size of difference being very large.

Table 1

MEAN SCORES OF PREOP- POSTOP PARAMETERS BY VISUAL DEFICIENCY IN THE WORST EYE

	Classification of visual deficiency - Worst eye					
	No visual deficiency (n=11)		With visual deficiency (n=17)		Cecity (n=25)	
	Preop	Postop	Preop	Postop	Preop	Postop
Mean hours slept during week nights (Mean +/- SD)	5.5 +/- 1.13	6.7 +/- 0.47	4.81 +/- 0.44	6.9 +/-0.66	5.01 +/-0.21	6.8 +/-0.65
Mean hours slept during weekend nights (Mean +/- SD)	6.1 +/- 1.22	7.1 +/- 0.54	5.1 +/- 1.50	7.0 +/- 0.71	5.31 +/- 0.24	7.0+/- 0.61
WHO-5 index (Mean +/- SD)	52.42 +/- 3.29	69.81+/- 6.33	34.61+/-4.28	64.51+/-3.41	39.41+/-8.10	65.4+/-14.14

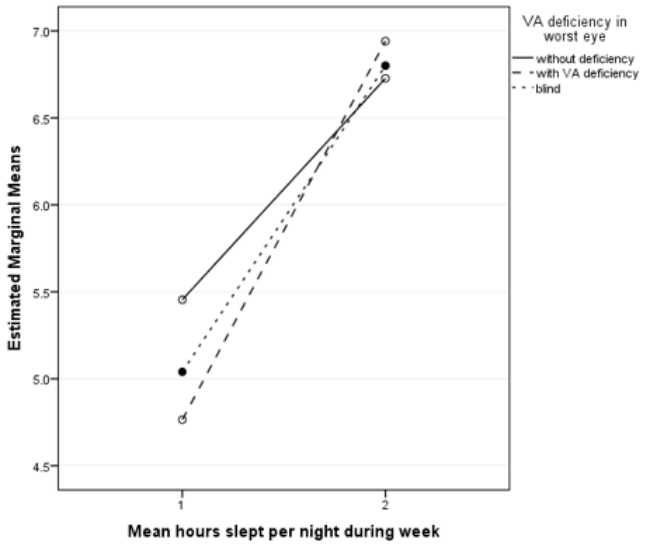

Fig. 1. Distribution of the evolution of the average number of sleeping hours during the week, initially and after surgery

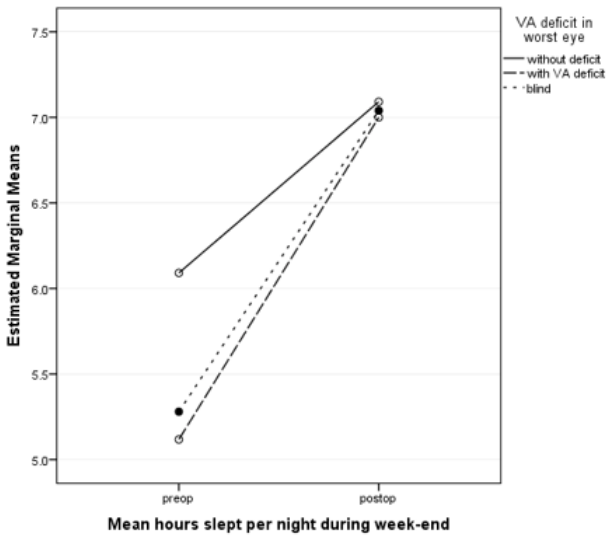

Fig. 2. Distribution of the evolution of the average number of sleeping hours during the weekend, initially and after surgery

State of well-being (WHO-5)

Pre-surgery

The state of well-being as general score has an average of 40.53 +/- 18.97 points, with a minimum of 4 and a maximum of 80 out of 100 possible points.

According to WHO instructions, allarm signals are raised by scores under 13 points which represent 9.4% in the analysed group (5). In the subgroup with the 13 points score, 80% (4) are patients with cecity, 20% (1) are patients with visual deficit. Patients without visual deficit are not represented in the subgroup with the score less than 13 points.

Pre-surgically, the WHO5 score is significantly lower in those who do not achieve 5 hours of sleep, both during the week, $U=147.5$, $z=-3.43$, $p=0.001$, $r=0.47$, with a medium to large difference size, and during the weekend $U=130.5$, $z=-2.88$, $p=0.004$, $r=0.39$, with a medium sized difference.

Post-surgery

Upon post-surgical assessment, the state of well-being as a general score has an average value of 66.04 +/- 14.24 points, with a minimum of 32 and a maximum of 92 points. None of the patients is classified with depression risk, i.e. with a score under 13 points. A mixed between-within subject analysis of variance was conducted to assess the impact of initial categories of VA deficit on participants index WHO-5, evaluated pre- and post-surgery. We found no significant interactions between the evolution of the WHO-5 score depending on the VA deficit categories, Wilks Lambda=0.891, $F(2.50)=3.04$, $p=0.056$, but we found that the pre- / post-surgical evolution of the WHO-5 index is statistically significant, Wilks Lambda=0.232, $F(1.50)=165.31$, $p<0.001$, partial eta squared =0.768, representing a large size effect (table 1).

The average change in the WHO5 score in between measurements correlates to the average number of additional hours upon the post-surgical assessment both during the week $\hat{o}=0.418$, $p<0.001$, $r=0.18$, and during weekends $\tau=0.385$, $p<0.001$, $r=0.15$, with small size associations for both.

Elderly persons present sleep structure disorders due to changes in the circadian system and decrease of daily activities [Kaneda, Furuta 2009]. Decreased light penetration through eye structures caused by cataract significantly contributes to circadian rhythm disturbances and may offer an explanation for the state of depression as well as for sleep disorders in this category of patients

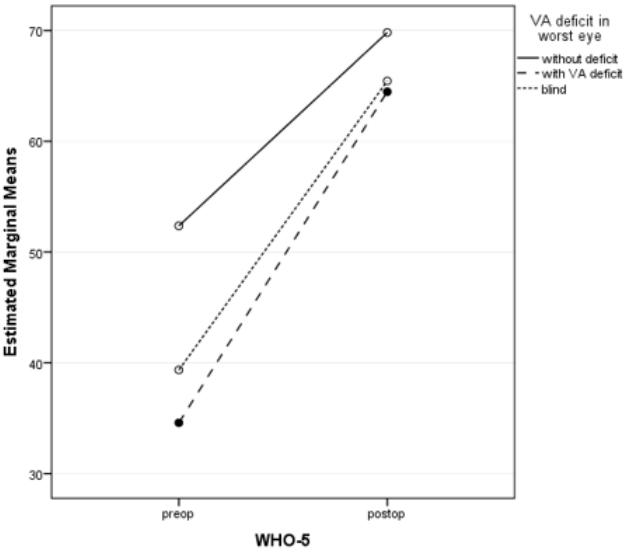

Fig. 3. Distribution of the average WHO5 score between initial and post-surgical situations, depending on the VA deficit

[Eramudugolla, Wood, Anstey 2013]. The National Sleep Foundation [Hirshkowitz, Whiton, Albert 2015] recently published recommednations on the required sleep duration, and in elderly adults they recommend an average of 7-8 h of sleep but they do not advise for less than 5 or more than 9 h. In our group the average duration is 5.04 +/ -1.27 h during the week and 5.40 h +/-1.35 for wekend nights, with 39.6% declaring under 5 h of sleep. Regarding sleep quality, 62.3% describe it as poor or very poor. The results of a prospective study [Ayaki, Muramatsu, Negishi, Tsubota 2013] showed that before cataract surgery 43.9% of participants had a poor sleep quality, situation which is similar to our results.

The WHO-5 Well-Being Index has an increased clinical sensitivity and proved to be a specific screening tool for depression [Topp, 2015]. Pre-surgically, 9.4% of the group is under the 13 points depression threshold, the patients included into this category belonging to the group with visual deficit and cecity. For the entire group the average index score was 40.53 +/- 18.97 points. The WHO-5 index is significantly lower in patients who achieve less that 5 hours of sleep per night, the size of the difference being medium to large. Acute sleep deprivation, interrupted sleep, sleep disorders and suboptimal sleep duration increase the homeostatic sleep drive. Increased

homeostatic sleep drive, due to any of these factors, raises the predilection to sleep and impairs neuro-behavioural performance [Bjorvatna and Pallesen 2009].

The initial severity of sleep parameters or WHO-5 index does not correlate with the visual deficit status.

One month after cataract surgery, patients reported between 5 and 8 h of sleep for week as well as for weekend nights. Sleep duration significantly increased after surgery, with an average increase of 1.79 +/-1.02 being reported for week nights and 1.62 +/- 1.16 increase for weekend nights. Other studies also observed significant improvements in slep duration 2 months after the surgical intervention but upon further measurements the improvements were not significant any more [Ayaki 2013]. Other studies also reported subjective improvements in sleep quality one month [Asplund, Ejdervik, Lindblad 2002], 2 months [Wei, She, Chen 2013] and 9 months [Asplund and Lindblad 2004] after surgery.

WHO-5 Well-Being Index no longer exhibits scores under the 13 points threshold in any of the patients, the minimum value of the recorded score being 32 points. The 25.5 +/- 13.62 points improvement compared to the presurgical situation is statistically significant. The WHO5 score improvement correlates to the additional number of sleeping hours upon postsurgical assessment, with a small size association.

The evolutuion of WHO5 score and of the average number of sleep hours per night deepnding on initial VA classes do not reach statistical significance. For the WHO5 index we observed that patients with visual deficit and those with cecity recover an average of 29.88 +/- 10.9 % and 26.1 +/- 15.1 %, respectively, while patients without visual deficit recover 17.5 +/- 11.1 %, each subclass being over the 10% proposed by the authors for a clinically significant change.

After control for potential confounders, other authors [Toa, Meulenersa, Fraser 2014] found significant decreases in depression symptoms after cataract surgery. Similarly to our results based upon the improvement of visual acuity, researchers found that the improvement of contrast, visual acuity and stereopsis did not significantly associate to changes in depression symptoms. The change in depression scores was not affected regardless of the surgical intervention site, i.e. the first or second eye.

The replacement of opaque eye structures increased light stimuli penetration which impress upon retin structures which are not involved in formation of images. The intrinsically photosensitive retinal ganglion cells expressing the photopigment melanopsin send projections to the lateral geniculate body and superior colliculus. These projections probably contribute to image formation but they might also contribute to the non-image forming function [Schmidt, Chen, Hattar 2011]. The intrinsically photo-sensitive retinal ganglion cells also send projections to the hypothalamus, especially into the suprachiasmatic nucleus (SCN), the master location of the circadian clock, and into the dorso-medial hypothalamus (DMH) especially involved in feeding behaviour and a relay between SCN and locus coeruleus (LC) in the brain stem [Schmidt 2011; Aston-Jones and Cohen 2005]. The direct projection from the intrinsically photosensitive retinal ganglion cells is sent to the ventrolateral preoptic nucleus (VLPO) and to the lateral hypothalamus (LH) containing orexigenic neurons, and it may mediate effects on sleep regulation [Schmidt 2011].

Randomized controlled studies proved the eficacy of strong light therapy in depression, accompanied by improvements in sleep quality and internal biological rhythm normalization. Bright light therapy (pale blue light at 7500 lux for one hour) singificantly decreased depression symptoms as compared to the control group who were administered difuse red light at 50 lux; an increase of salivary melatonin levels in the evening and improvements of actigraph measured sleep parameters were also recorded [Lieverse, Nielen, Veltman 2008; Lieverse, Van Someren, Nielen 2011].

In a WHO study [Shah, Gilbert, Razavi 2011] on 11 048 cataract interventions, patients with visual acuity < 6/60 for the eye to be operated represented 47% of the total number of interventions in weakly developed countries and 1% in developed countries, the difference being statistically significant. In our study, patients with presurgical VA < 6/60 for the eye to be operated represented 47.2%, score which is similar to weakly developed countries.

From a public health perspective, interventions aiming to educate population to recognize cataract symptoms and to increase the addressability to ophtalmology specialists appear as justified. We recommend lens implant interventions before visual deficit and cecity occur, due to the profound socio-economic consequences of these diseases by reduced productivity, increased rehabilitation costs which represent a burden on the individual, family and society. Neglecting visual deficits and cecity contribute to increased morbidity by occurence and aggravation of circadian rhythm dirorders, an increased risk factor for depression [Monteleone, Martiadis, Maj 2011], insomnia [Lack and Wright 2010], obesity [Froy 2010], diabetes [Gale, Cox, Qian 2011], cardiovascular diseases [Puttonen, Harma, Hublin 2010] and cancer [Savvidis and Koutsilieris 2012].

Conclusions

Elderly cataract patients have an increased probabilitty to suffer from decreased sleep duration, reduced self-assessed sleep quality, but also from depression symptoms

Presurgically, the average sleep duration under 5 h is associated to a more severe WHO5 depression score, but none of the measures is correlated to the degree of visual acuity.

The one month assessment after cataract surgery shows a significant increase in sleep duration and quality, and a significant improvement of the WHO5 index, with none of the patients reporting a sleep duration under 5 h or a WHO5 index under 13 points, which would represent an orientative threshold for the diagnosis of depresion.

The initial clinical situation does not influence the size of sleep duration evolution and WHO5 index, additionally supporting our recommedations to perform cataract surgery early after the onset of symptoms not allowing the aggravation of visual deficits because, together with the increased mortality and morbidity characteristic for persons with visual deficit and cecity, an increase in social dependance occurs, these representing neuralgic points for Romanian public health.

References

1.ALLGAIER, A.K,, KRAMER, D., SARAVO, B., et al., International journal of geriatric psychiatry, **28**, 2013, p. 1197-1204.
2.ASPLUND, R., EJDERVIK LINDBLAD, B., Arch Gerontol Geriatr, **35**, 2002, p. 179-187.
3.ASPLUND, R., LINDBLAD, B.E., Arch Gerontol Geriatr, **38,** 2004, p. 69-75.
4.ASTON-JONES, G., COHEN, J.D., Annu Rev Neurosci, **28**, 2005, p. 403–450.
5.AYAKI, M., MURAMATSU, M., NEGISHI, K., TSUBOTA, K., Rejuvenation research, **16**, 2013, p. 35-42.
6.BJORVATNA, B., PALLESEN, S., Sleep Medicine Reviews, **13**, 2009, p. 47–60.

7.ERAMUDUGOLLA, R., WOOD, J., ANSTEY, K.J., Front Aging Neurosci, **5**, 2013, p. 56.
8.FROY,O., Endocrine reviews, **31**, 2010, p. 1-24.
9.GALE, J.E., COX, H.I., QIAN, J., BLOCK, G.D., COLWELL, C.S., MATVEYENKO, A.V., Journal of biological rhythms, **26,** 2011, p. 423-33.
10.HIRSHKOWITZ, M., WHITON, K., ALBERT, S.M., et al., Sleep Health: The Journal of the National Sleep Foundation, **1**, 2015, p. 223-330.
11.The WHO-5 website https://www.psykiatri-regionh.dk/who-5/who-5/questionnaires/ Pages/ default. aspx
12.KANEDA, R., FURUTA, H., Japanese Journal of Clinical Medicine, **67**, 2009, p. 1548-1552.
13.LACK, L.C., WRIGHT, H.R., In Clinical Handbook of Insomnia, Humana Press, 2010, p. 243-253.
14.LIEVERSE, R., NIELEN, M.M., VELTMAN, D.J., et al. Trials, **9**, 2008, p. 48.
15.LIEVERSE, R., VAN SOMEREN, E.J., NIELEN, M.M., et al., Arch Gen Psychiatry, **68**, 2011, p. 61-70.
16.MCALINDEN, C., GOTHWAL, V.K., KHADKA, J., et al., Ophthalmology, **118**, 2011, p. 2374-2381.
17.MONTELEONE, P., MARTIADIS, V., MAJ, M., Progress in Neuro-Psychopharmacology and Biological Psychiatry, **35**, 2011, p. 1569-1574.
18.PUTTONEN, S., HARMA, M., HUBLIN, C., Scandinavian journal of work, environment & health, **1,** 2010, p. 96-108.
19.SAVVIDIS, C., KOUTSILIERIS, M., Mol Med.;**18**, 2012, p. 1249-1260.
20.SCHMIDT, T.M., CHEN, S.K., HATTAR, S., Trends Neurosci. **34**, 2011, p. 572–580.
21.SHAH, S., GILBERT, C.E., RAZAVI, H., et al., Bull World Health Organ. **89**, 2011, http://dx.doi.org/10.1590/S0042-96862011001000014.
22.TOA, C.G., MEULENERSA, L.B., FRASER, M.L., et al., International Psychogeriatrics, **26**, 2014, p. 307-313.
23.TOPP, C., W, OSTERGAARD, S., D, SØNDERGAARD, S., BECH, P., Psychother Psychosom, **84**, 2015, p.167-176.
24.WEI, X., SHE, C., CHEN, D., et al., J Clin Sleep Med, **9**, 2013, p. 741-745.
25.WHO. Good health adds life to years Global brief for World Health Day 2012 Avaliable from http://apps.who.int/iris/bitstream/10665/70853/1/WHO_DCO_WHD_2012.2_eng.pdf.
26.WHO. Universal eye health: a global action plan 2014 - 2019. Available from: http://www.who.int/blindness/AP2014_19_English.pdf?ua=1, accesed 14.09.2015

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