

IS IT POSSIBLE TO VERIFY RELATIONS BETWEEN LOW VISION AND SLEEP PATTERNS THROUGH ACTIGRAPHY? CASE REPORT OF A PARA-ATHLETE

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ABSTRACT: Verify if the actigraphy can set relations between low vision and sleep disorders in a para-athlete. Questionnaires, sleep diary and actigraph were used during 30 days. The participant presented an indifferent circadian profile, with preference for evening training and poor subjective sleep quality. Periodogram with circadian rhythm and actogram showing irregularities in the times to sleep and wake up on weekends, with periods of day rest throughout the week. The average sleep time was 06h30m with six awakenings per night. It was found that environment, habits and routines contributed to poor sleep quality. Actigraphy, when combined with other methodologies, proved to be useful for establishing relationships between low vision, sleep quality, exercise and self-perception. In addition to contributing, in this study, to directing sleep hygiene measures, allowing the promotion of improvements and gain in quality of personal and professional life.

KEY WORDS: Chronobiology phenomena; Quality of life; Sleep hygiene; Vision disorders.

É POSSÍVEL VERIFICAR RELAÇÕES ENTRE BAIXA VISÃO E PADRÕES DE SONO POR MEIO DE ACTIGRAFIA? RELATO DE CASO DE UMA PARATLETA

RESUMO: Verificar se a actigrafia permite estabelecer relações entre baixa visão e distúrbios do sono em uma paratleta. Utilizou-se questionários, diário do sono e actígrafo durante 30 dias. A participante apresentou perfil circadiano indiferente, com preferência para treinos vespertinos e má qualidade subjetiva de sono. Periodograma com ritmo circadiano e actograma evidenciando irregularidades nos horários para dormir e acordar aos finais de semana, com períodos de repouso diurno ao longo da semana. A média de sono foi de 06h30m com seis despertares por noite. Verificou-se que ambiente, hábitos e rotinas contribuíram para a má qualidade de sono. A actigrafia, quando aliada a outras metodologias, mostrou-se útil para estabelecer relações entre baixa visão, qualidade do sono, prática de exercícios e auto percepção, além de contribuir, neste estudo, para o direcionamento de ações de medidas de higiene do sono, permitindo a promoção de melhorias e ganho em qualidade de vida pessoal e profissional.

PALAVRAS-CHAVE: Deficiência visual; Fenômenos da cronobiologia; Higiene do sono; Qualidade de vida.

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Recebido em: 18/02/2020

Aceito em: 18/05/2020

INTRODUCTION

Sleep disorders in humans has been a topic of several researches in Brazil and around the world, nevertheless, there are fewer studies when this theme is connected to the population that has some kind of visual impairment. In Brazil, there are more than 6,5 million people with visual impairments, including 528.624 thousand blind people and 6.056.654 million with low vision, according to the Brazilian Institute of Geography and Statistics (IBGE) based in the 2010 Census¹. Visually impaired people commonly show circadian periodic dyssynchrony, furthering cyclic bad quality of sleep episodes and daytime disfunction severely interfering in social, academic and professional life².

In healthy individuals, the sleep demand occurs through a homeostatic pressure, that increases during a vigil period and is dissipated by sleep, representing, thus, the sleep necessity. The rhythm is controlled by suprachiasmatic nucleus (SCN) in the anterior hypothalamus, presenting a 24-hour pattern, even without temporal environmental clues, being light the principal synchronizer of the sleep/rest cycle³.

In absence of light perception, people who cannot differentiate if a room's light is on or off, occurring what is called circadian rhythm in free course. The consequence is that, in most of the cases, the circadian rhythm stops presenting a 24-hour period, expressing bigger or smaller values⁴. It is important to highlight that there are cases where blind people keep the neural photographic information system intact, as in the case of melanopsin and retino-hypothalamic treat⁵.

This way, visual impaired individuals that has low light perception can oscillate between synchronized rhythms with the external environment light, showing activity and rest rhythms of 24 hours or out of phase moments, delaying or anticipating the 24-hour endogenous rhythm. The presence of sleep disorders and intensity depends on whether there is residual vision, or not⁶.

The sleep and rest cycle is a endogenously regulated rhythm and synchronized by temporal clues like the light-dark cycle, family commitments, workday, days

off and weekends, time to wake up and sleep, physical exercises practice².

Considering that the biological rhythm and temporal organization perception in human species, mainly in urban centers, are linked to the commitments related to work, school and other social events and not just to environment changes caused by geophysical events, like the case of light/dark cycle in a 24-hour period, people with low vision would not have synchronization with the environment difficulties, due to the vision situation or the reception of light by retina, since the house, school, and other rhythms would serve them as temporal marks.

This research aimed to evaluate if the actigraphy can be a useful tool to stablish relation between low vision and sleep disorders of a para-athlete with complains about poor sleep quality.

METHODOLOGY

A case research was performed, through sleep diary registry and an Condor® actimeter, besides the sociocultural questionnaire, chronotypes profile and sleep quality, with a para-athlete with low vision.

Daily activity and rest patterns were valued, during 30 consecutive days, in a 38 year old para-athlete with low vision (CID 10-H54.2;F12). To record the behavior and rhythm of the activity period and circadian rest the participant used the non-dominant (left) arm, including during the night while sleeping, an ActTrust-Actimeter / Condor® wristwatch and filled out, for 30 consecutive days, morning and evening, a sleep diary prepared by the authors.

The circadian profile was verified by the Chronotypes questionnaire⁷. To check an individual's chronotype, *Horne and Ostberg proposed a questionnaire, A Self-Assessment Questionnaire to Determine Morningness-Eveningness in Human Circadian Rhythms*, published by the International Journal of Chronobiology em 1976.

The scores vary between 16 and 86; the higher scores indicate morning individuals and the lower, evening individuals. This questionnaire offers a classification in relation to morning and evening following this score:

16 to 33, for evening individuals; 34 to 44, to moderate evening individuals; 45 to 65, to indifferent; 66 to 76, to moderate morning individuals; 77 to 86, to morning.

To rate the subjective quantity of sleep we used the PSQI (Pittsburgh Sleep Quality Index)⁸, composed by 19 items with the purpose of evaluating and identifying the sleep quality and disorders in the last thirty days. The 19 items are utilized as score to, subjectively, rate the sleep quality, the latency, the duration, the feeling of adequate and enough sleep, the disorders, medicine use and daytime somnolence.

A questionnaire with questions related to sociocultural information and reproductive cycle (premenstrual syndrome (PMS) symptoms and menstrual cycle control) was formulated by the authors.

The data collected from the questionnaires were inserted in a database in the program Microsoft Excel 2010, for analysis. The actigraph records were analyzed through ActStudio, actimeter analysis software. All the methodological procedures were approved by the Ethic in Research with Human Beings Committee of Maringá State University. (Zip Code: 3.383.966).

RESULTS

Regarding the general questions of the sociocultural questionnaire, the participant reported being married, with three children, having studied up to the 6th year of elementary school. She has little reading habit, as she finds it very difficult to see the letters in a book. However, she never felt the need to learn Braille.

She usually likes to use her cell phone to listen to music or browse social networks. The latter with the cell phone very close to the eyes and using maximum size of letters. She started practicing professional sport at the age of 22, in the weight throw and javelin/discus throw. While on a trip to participate in the Olympic games, she classified the adaptation to the time zone of the visited country, namely Japan, as very difficult, which presents 12 hours in relation to the official Brazilian time.

Regarding the low vision diagnosis she informed to distinguish light and dark (CID10-H54.2;F12), however, due to the gradual vision loss that has been happening

lately, it was prescribed in her last ophthalmic exam, the need to use a walking stick, what made her feel down, but aware of the importance of using the orthosis, especially when using public transport to go and come back from training. The beginning of the vision loss was noticed around 7 years old, being diagnosed with glaucoma, cataract, strabismus, myopia and astigmatism.

To measure an individual's chronotype we use as a pattern scores from 16 to 33, to evening individuals; from 34 to 44, for moderate evening; 45 to 65, for indifferent; 66 to 76, for moderated morning individuals; 77 to 86, for morning profile individuals⁷.

In this questionnaire, she got a 57 score, what allows to classify her as an indifferent profile. Crossing this data with the question "when do you like to practice?" of the sociocultural questionnaire, showed that the answer was "in the middle of the afternoon". The daily activity profiles and exposure to light obtained through the actimeter records, confirms this data when highlighting a peak of activity between 15 and 16 hours. (Image 1) and bigger explosion to light in the afternoon (Image 2).

The Pittsburgh questionnaire (PSQI) is composed by 19 items and has the aim to evaluate and identify the quality of sleep and the disorders in the last thirty days. The 19 items are used as score to, subjectively, evaluate the sleep quality, the latency, the duration, the feeling of enough sleep, the disorders, the use of medicines and daytime somnolence.

The seven components of the PSQI's scores are added to check a global score, that varies from 0 to 21. Scores from 0 to 4 indicate a good sleep quality, from 5 to 10 indicate a poor sleep quality and above 10 indicates sleep disorders. The bigger the score, the worse the quality of sleep. A > 5 PSQI score indicates that the individual presents a big difficulty in at least 2 components, or moderated difficulty in more than 3 components⁸.

The participant showed a PSQI = 8 result, characterizing poor quality of sleep. Comparing this result with collected data from the sociocultural questionnaire (Chart 1), it is verified that the environment, habits and routines contribute to having poor sleep quality.

Some of the questions included in the sociocultural questionnaire were directed to issues referring to self knowledge linked to reproductive cycle.

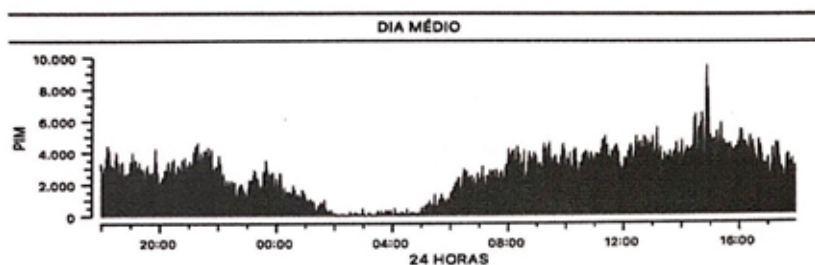


Figura 1. Perfil médio de atividade e repouso nas 24 horas do dia, com pico de atividade entre 15 e 16 horas.
Fonte: ActTrust-Actímetro/ Condor®.

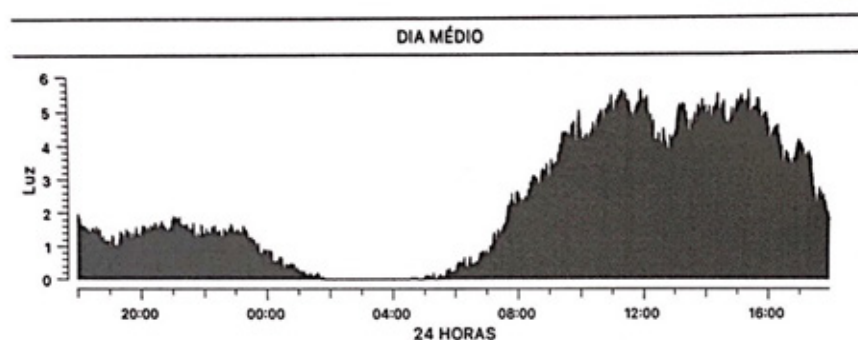


Figura 2. Perfil médio de exposição à luz nas 24 horas do dia, com pico de exposição no período vespertino.
Fonte: ActTrust-Actímetro/ Condor®.

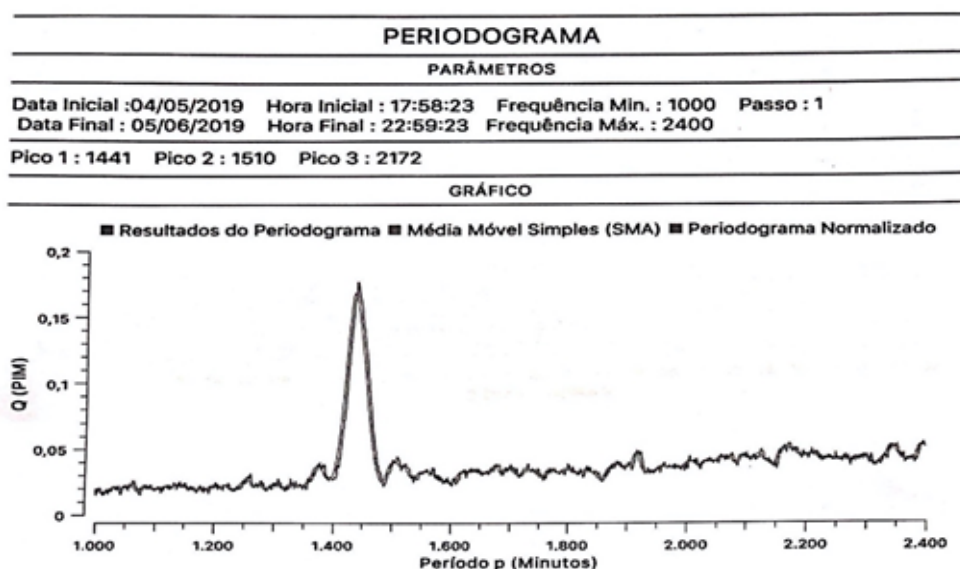


Figura 3. Periodograma evidenciando ritmo circadiano (24 horas), com pico em 1441.
Fonte: ActTrust-Actímetro/Condor®.

It was seen that the menstrual cycle control is done subjectively, without the help of any apps or calendars. In relation to premenstrual syndrome (PMS) she reported symptoms like headache, aggressivity and increased appetite for chocolate, recognizing them before the menstruation. She also informed that the PMS

interferes in her sleep – “sleeps less and worse”, but it helps in competition days.

Subjective data referring to mood, collected with the sleep diary pointed delay in menstruation and an accentuated irritability in the last five days. The mood average (from 0 to 10) was 6,1, during the 30 days, and

Quadro 1. Questões relativas ao ambiente, hábitos e rotinas coletadas pelo questionário sociocultural, elaborado pelas autoras

Questões do questionário sociocultural relativas ao ambiente, hábitos e rotinas antes de dormir	Respostas da participante
Você considera que seu bairro é um local tranquilo ou barulhento para dormir?	“Muito barulhento”
Tem aparelho de ar condicionado no quarto em que você dorme?	“Não. Só um ventilador silencioso”
Você costuma deixar alguma luz acesa em seu quarto durante a noite?	“Não deixa luz acesa”
Você tem televisão no quarto de dormir?	“Sim e fica ligada a noite toda”
Até quanto tempo antes de dormir você usa o celular	“± 01h30 minutos”
Qual a sua preferência ao usar o celular?	“Ouvir música/Entrar nas redes sociais”
Você utiliza o celular após se deitar?	“Não utiliza”

Quadro 2. Resumo Estatístico.

RESUMO ESTATÍSTICO								
	Hora que deitou	Hora que levantou	Tempo na cama (horas)	Tempo total de sono (horas)	Latência (horas)	Eficiência do sono (%)	Waso (minutos)	#Despert
Min	21:46:23	05:03:23	05:23:00	05:15:00	00:00:00	77,19%	00:06:00	2
Máx	01:56:23	09:42:23	10:17:00	09:13:00	00:37:00	98,14%	01:41:00	17
Méd	23:50:08	07:07:13	07:17:05	06:30:02	00:03:10	89,53%	00:43:02	6.046167
Dp	00:56:53	01:10:48	01:12:30	01:03:06	00:07:19	5.84%	00:30:06	3.52

Fonte: ActTrust-Actímetro/Condor®.

3,8, during the last five days of use of the actimeter. The highest score for mood during the 30 days, was 9 and the lowest 1. During the last five days the highest score was 7 and the lowest 1.

The actimeter registry shows a periodogram with synchronized circadian rhythm (Image 03). And the statistic summary (Frame 1) evidences that the time spent in bed at night was, on average, 07h17m and, sleeping, 06h30m, with an average of six awakenings per night and average rest time after the start of the sleep (WASO) of 43 minutes, with latency of sleep in)# minutes.

In the actogram it was possible to verify irregularities in sleeping and waking up time, especially on weekends, as well as multiple periods of rest at daytime during the week. The sleep period is marked by multiple activity moments.

DISCUSSION

The training routine of the participant had and has an important part in day/night cycle synchronization

with rest/wake rhythm, contributing to the sleep pattern inside the normality cases, considering that low vision can, in some cases, have negative influence on the circadian rhythm.

Visual impairment occurs in the form of low vision, which is the decreased visual capacity and perception of masses, colors and shapes and blindness, in which visual acuity in the best eye is equal to or less than 20 / 200. Race / ethnicity, age, language, sex or gender, poverty and low education aggravate the impact of efficiency, leading to even more precarious health and quality of life. People with disabilities commonly share the experience of living with significant limitations in their daily activities and, as a result, generally experience exclusion from participation in their communities.⁹

Pedagogically, however, those who, despite having subnormal vision, need instruction in Braille or by text reading software are delimited as blind. Those with subnormal vision and who can read enlarged printed types or with the aid of optical resources are considered like low vision individuals. This definition is closer to the

International Classification of Functionality, Disability and Health - CIF¹⁰.

The idea of exclusion addressed by society occurs to the extent that the characteristic of the human being negates the limit, or average, imposed as tolerable. In this way, a difficulty is created in the social positioning of people with disabilities in relation to family members and groups to which they relate³. The results obtained with the application of the socio-cultural questionnaire, allow us to infer that the participant has a good ability to adapt to adversity, given the early onset of loss of vision, low education, the formation of a family with three children and a professional career in sport, maintained with an athlete scholarship, beginning at 22 years of age.

The theory of full intelligence, which advocates practical intelligence used to solve everyday problems, to the detriment of general intelligence, measured by tests, is based on the ability demonstrated by an individual to succeed in a given socio-cultural context, taking advantage of their potentialities and compensating the disadvantages in order to adapt, select and model the environment through the combination of nalitic, creative and practical skills¹¹.

The positive coping of the participant, due to the decrease in visual acuity seen in the last routine medical examination, for the use of orthosis when the use of public transportation is necessary, as well as the perception that sleeping poorly was interfering negatively in the results of her training and in her personal life, showed genuine interest in the value of self-knowledge for personal and professional growth. It is also important to highlight that despite subjectively controlling her reproductive cycle, it directs the aggressiveness of the period of premenstrual tension to obtain better results in the championships. Following this line of thought, the ideas of the aforementioned authors corroborate the inferences made in this study with regard to the participant's ability to adapt.

Regarding the circadian rhythm, the results showed a chronobiological profile with a tendency to indifference. The circadian rhythm behaves differently for each individual throughout the day, it is important to know at what time the peak of willingness or tiredness occurs, so that you can target and get the best possible

return of each activity. The main differences between morning, afternoon and indifferent people are the preference to wake up and sleep, which have an influence on the performance of their daily activities¹².

The afternoon is the period in which evening athletes perform their training, as it is close to the time when the body temperature rises, and this is a physiological action¹³. The results obtained with the application of the socio-cultural questionnaire, corroborate the findings in the questionnaire of chronotypes, showing the preference for training in the afternoon.

Actigraphy is a technique that allows you to estimate activity and rest, throughout the 24 hours, in addition to other parameters such as total sleep times, in bed and awake, how many awakenings during the night and sleep latency, due to the records it makes of the movements of the parts of the body¹⁴. With the data obtained through actigraphy, a daily profile of activity and exposure to light was evidenced, corroborating the data mentioned above, since a peak of daily activity is observed between 15 and 16 hours and greater exposure to light in the afternoon.

In this study, low vision was not enough to interfere with the synchronicity of the circadian rhythm, which can be seen in the periodogram, which peaked at 1441 minutes. Following the reasoning that the circadian rhythm is controlled by the suprachiasmatic nuclei of the hypothalamus and that this, in turn, is synchronized by the light in a 24-hour period, it can be inferred that in the case of the participant, the rhythm was not lost, because the light, in addition to stimulating cones and rods, receptors responsible for the production of images, also activates specific cells located in the retina, whose photoreceptor is melanopsin.

The light / dark cycle is considered the main zeitgeber (synchronizer) for the human species, capable of promoting a stable relationship between biological rhythms and environmental oscillations. Thus, the various endogenous processes, such as hormone secretion, temperature variation, the wake / sleep cycle, remain adjusted to the environment, a condition for the functioning of a healthy organism and the promotion of quality of life. In this sense, it is important to emphasize that there are records in the literature of cases of

totally blind people who keep the neural photographic information system intact¹⁵.

The decrease in vision starting in childhood was, according to what was mentioned in the sociocultural questionnaire, caused by several factors, such as glaucoma, cataracts, strabismus, myopia and astigmatism, classifying her as a para-athlete in the category CID 10-H54.2; F12. These data corroborate with research results that explain that the child is more vulnerable to visual disorders due to the rapid growth and development of the sight¹⁶.

In order to obtain a diagnosis of sleep disorders it is recommended to use several tools, for at least seven days, such as the sleep diary, actigraphy, in addition to morning / evening questionnaires and others that allow to evaluate the subjective sleep pattern in the past thirty days¹⁷. The objective data regarding quality and quantity of sleep, obtained during the 30 days of use of the actimeter, showed an average of six awakenings per night, equivalent to a total of 43 minutes awoken throughout the night. The actogram showed irregularities in the times to sleep and wake up, especially on weekends and several periods of daytime rest throughout the week.

When the results of the actigraph were compared with the subjective results, obtained with data collected from the sociocultural questionnaire and the Pittsburg questionnaire, we verified that environment, habits and routines contribute to the poor quality of sleep reported by the participant, which is worrying, given the importance of sleep in the recovery of daytime activities and conservation of central nervous system processes¹⁸. In addition to this, research results showing the existence of fibers that from the retina project directly into the ventrolateral preoptic nucleus blocking the inhibitory effect that these neurons have on the ascending activator system of the brain stem, explaining why light makes it difficult to fall asleep¹⁹.

Mood swings are commonly reported in people who have a misalignment between the circadian system and environmental times and were evidenced by researchers²⁰ who pointed out associations of circadian rupture with mood disorders. The present study showed a circadian system aligned and mood changes more evident during the period referred to as premenstrual tension.

A menstrual cycle is divided into the follicular (during menstruation), ovulatory (post menstrual) and luteal (premenstrual) phases. In each one there are changes in the concentrations of estrogen and progesterone, resulting in physiological effects on the female body, such as changes in the thermoregulatory, respiratory, cardiovascular, nervous system, among others; which can influence the production of muscle strength and endurance²¹.

The para-athlete of this study referred to one of the symptoms of PMS, the aggressiveness, which according to her, becomes positive during training and when it coincides with competition season. Biological individualities make women - athletes or non-athletes - feel positive or negative changes during training, while others show no change in performance during the different phases of the menstrual cycle²². Research results²³ corroborate these data by highlighting that women's sports performance, as an individual factor, can reflect in different ways, where athletes already achieved excellent results in different phases of the menstrual cycle.

Commonly, significant associations are found between individuals with visual impairment and symptoms of depression, and some determinants for this symptom cannot be controlled, requiring health professionals to act in order to promote action aimed at improving mental health, quality of life and social inclusion of this population²⁴.

Other studies²⁵ show that physical exercise can cause significant effects in the phase change, facilitating the synchronization of the light / dark cycle with the wake / sleep rhythm. By non-photic pathways, physical exercise can be linked to the circadian timing system, which can benefit the health of individuals in various situations, such as those affected by stress, anxiety, sleep disorders and depression²⁶. These results support and corroborate those found in this research.

In view of promoting physical and mentally restful sleep, sleep hygiene, a set of actions and daily practices, initiated during the day and extended until the time of sleep onset, has proved to be of great use²⁷. The results obtained in this case study show that this set of behavioral rules can be of great help to minimize or even

resolve the complaint of poor sleep quality reported by the participant.

It is important to emphasize that physical exercise has been a great ally in the sense of facilitating circadian synchronization, but due to the fact that she is a professional in the area, one must not forget that the training is daily and, often, intense, which can lead to fatigue. Competing means facing challenges and questions that can, depending on individual and situational aspects, represent a considerable source of stress for athletes, depending on their physical, technical and psychological attributes²⁸. Add to that, her double journey as a family mother.

Other researchers^{29,30} add that the athlete's physical preparation involves several body resources to perform their tasks, motor skills such as strength, endurance, agility, flexibility are fundamental in competitive sports. In their studies they stated that, although physical aspects are the main characteristic of sports training, they ensure that the psychological preparation of athletes can make a difference.

CONCLUSION

Actigraphy, when combined with other methodologies, proved to be useful for establishing relationships between low vision, sleep quality, exercise and self-perception, in addition to contributing to the direction of sleep hygiene measures, allowing the promotion of improvements and gain in quality of personal and professional life.

It was found that irregularities in sleeping and waking times, especially on weekends, combined with various periods of daytime rest throughout the week, may have been the main villains for the subjective understanding of poor sleep quality reported by the participant.

It is important to point out that sleep hygiene measures, although they may seem obvious, can be totally ignored, since they are based on behavioral changes. However, in this study we have the participation of the participant, which contributed greatly to the understanding

of the results obtained and the predisposition to perform the necessary actions to achieve restful sleep.

The main guidelines were in relation to the need for adjustments in the environment (TV, comfortable bed / blanket, dark room, switched off electronics, including standby mode) and the gradual change of some ingrained habits, such as maintaining a bedtime and waking up routine, including at the end of week, minimal or no use of cell phone in bed, avoid drinks containing caffeine after 4 pm, for example.

We understand that additional studies relating to visual impairments, sleep disorders and psychological stress are necessary and will certainly contribute to improving the quality of life of these people, in addition to allowing referral to a multidisciplinary team, if necessary.

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