

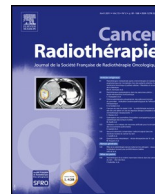


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## Impact of the use of Luminette<sup>®</sup> on well-being at work in a radiotherapy department

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### a b s t r a c t

#### Keywords:

Light therapy  
Health promotion  
Depressive symptoms  
Work  
Radiotherapy

**Purpose.** – Studies showed the beneficial effect of light therapy on well-being at work. Our randomized cross-over study aimed at analysing the effects of light exposure with the use of Luminette<sup>®</sup> in a hospital department without access to natural light.

**Materials and methods.** – The study design proposed an alternation between two periods of four weeks of use of Luminette<sup>®</sup> and two periods of four weeks without Luminette<sup>®</sup>. After every period, participants completed questionnaires (sociodemographic data, seasonal and general depression, anxiety, quality of sleep, slumber and general health).

**Results.** – Twenty-five persons participated in the study (average age = 36.5, SD = 7.7). The sample showed several benefits after one month of Luminette<sup>®</sup>: diurnal slumber ( $P = 0.046$ ), general health perception ( $P = 0.026$ ), physical functioning ( $P = 0.042$ ), pains ( $P = 0.023$ ) and role limitations due to emotional problems ( $P = 0.013$ ). One month later, certain benefits remained without light therapy: diurnal slumber ( $P = 0.028$ ), pains ( $P = 0.044$ ) and emotional problems ( $P = 0.042$ ). **Conclusion.** – This study has showed that the use of Luminette<sup>®</sup> could lead to similar positive results to those obtained with light therapy in other studies. This study has confirmed that Luminette<sup>®</sup> could have a positive effect on well-being at work.

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## 1. Introduction

In the general population, atypical depressive symptoms (sugar cravings, prolonged sleep, weight gain and increased appetite, limb heaviness, irritability) may appear in association with low exposure to light in the winter, indoors, and outdoors in northern latitudes [1–4]. The effects of these symptoms may include a lower professional and social function [5]. Scientific studies have demonstrated the beneficial effect of daily ocular exposure to light at intensity and spectrum near that of sun light [6]. The beneficial effect of light seems attributable to its effect on the secretion of melatonin, the so-called sleep hormone, and of a neurotransmitter, serotonin. In healthy subjects, Partonen and Lonnqvist have demonstrated that exposure to bright light in the winter was effective to improve quality of life and relieve the distress of subjects suffering from seasonal symptoms as well as those who do not suffer from seasonal variations [4]. Other studies have shown the beneficial effect of modifying light exposure on performance and well-being at work during the day [7,8]. In the study of Viola and al., lighting changes (white light upgraded to blue light) during working hours led to an increased feeling of subjective alertness, and improvements in performance and fatigue [8]. To our knowledge, this is the only study on this subject focusing on the workplace. However, as it may not always be possible to modify lighting in the entire workplace, an alternative exists on the individual scale in the form of Luminette® (Lucimed), a personal light device more easily implemented on the workplace.

Our randomized cross-over study aimed at analysing the effects of light exposure with the use of Luminette® in a specific workplace: the radiotherapy department located in the third sublevel of the Liège university hospital. This level is almost completely devoid of windows, and provides little access to daylight. In addition, radiation therapy was one of the first medical specialty to implement quality assurance programs in its daily processes. For a long time, these programs remained focused on the equipment performance, but are increasingly concerned with the human factor, including the performance of healthcare professionals [9]. At present, optimizing patient, professionals and public safety, along with risk mitigation, are major considerations in this medical field [10].

## 2. Material and methods

### 2.1. Subjects

Participation was offered to the 100 staff members (secretaries, nurses, doctors, psychologists, physicians) working in the radiation therapy department of the Liège university hospital. Each received a brochure outlining the basic protocol, and was asked to fill a health questionnaire to determine admissibility to the study. The admissibility criteria were employment in the radiation therapy department at least part time, and voluntarily acceptance to participate to the whole study.

Exclusion criteria were certain medical conditions (progressive eye disease, severe overall medical conditions, current psychotropic medication, substance or alcohol abuse, psychiatric disorders including psychosis, severe personality disorder requiring professional attention) and refusal to comply with assessments included in the study.

### 2.2. Protocol

The cross over randomized study was divided in two blocks: ABAB for one half of the participants (group 1), and BABA for the other (group 2), where two four-week periods of using Luminette® (A) were alternated with two four-week periods of not using Luminette® (B). This pattern made it possible to control the variations of measurements due to environmental changes (season, climate, etc.) instead of light exposure, and also to use a more limited number of Luminettes®. Subjects were divided at random (by draw) between both groups and assessed on five occasions: prior to the start of alternate periods, and following each of the four four-week periods. The study started in October 2011 and ended in March 2012, for a total duration of five months. Five assessment periods were alternated between four intervention periods.

### 2.3. Questionnaires

Participants answered a series of pre-study questionnaires: a socio-demographic questionnaire, the Structured Interview Guide for the Hamilton Depressive Rating Scale-seasonal affective disorders version (SIGH-HDRS), the Beck Depression inventory II (BDI-II), the Beck Anxiety Inventory (BAI), the Pittsburgh Sleep Quality Index (PSQI), the Epworth Sleepiness Scale (ESS) and the Short Form 36- items Health Survey (SF-36) [11–16]. Then, they filled all questionnaires at the end of each of the four four-week periods (except for the socio-demographics questionnaire). The SIGH-HDRS, a multiple choice 17 item depression scale measuring the severity of the depressive state [11], as well as eight typical symptoms of seasonal affective disorder (SAD). The BDI measures the level of depressiveness on 21 items with four possible answers (0 to 3) [12] with scores ratings between 0 and 63. Beck and al. used four categories to define the level of depressiveness: 0–9: minimal depression; 10–18: mild depression; 19–29: moderate depression ; 30–63: severe depression [17]. The BAI measures the intensity of 21 anxiety symptoms on a scale of 0 (no anxiety) to 3 (severe) during the preceding week [13] with overall score between 0 and 63. The PSQI comprises 19 self-assessment questions in seven on seven components, each assessed on a scale of 0 to 3 points [14]. Overall score higher than 5 indicates sleep disturbance for one or more components. The ESS measures daytime slumber [15]. Scores higher than 8 indicate the absence of sleep debt, 9 to 14 significant sleep debt, and higher than 15 indicate signs of excessive daytime sleepiness. SF-36 measures general health on eight criteria: physical functions,



**Fig. 1.** The Luminette®.  
Luminette®, light therapy device.

Role limitations due to physical issues, pain, perception of overall health, vitality, social function, role limitations due to affection problems, general mental health and general physical health [16]. The higher the scores, the better the health.

#### 2.4. Light therapy

The light emitted by the eight light emitting diodes (LED) in the Luminette® is reflected on a holographic visor to channel the light on the pupil (Fig. 1). Then, light is directed, regardless of the gaze direction and head position, on the lower part of the retina. -

This system generates an even distribution of light on the glasses, without risk of glare. Luminette® has a specific, highly blue spectrum. The subjects used Luminette® at work in the morning between 7:00 and 9:00 for a maximum of 30 minutes daily, at least five days a week.

#### 2.5. Data analysis

Data was analysed using software SPSS 13.0[18]. The data for both groups (group 1 following protocol ABAB, and group 2 BABA) was compared using T-tests with multiple variables (age and various psychological tests) at each evaluation to assess any possible difference. Following this, averages were comparatively analysed (T pairs) between reading times for the entire sample.

### 3. Results

#### 3.1. Participants

On the 100 members of the radiation therapy department, 25 volunteered for the study and agreed to participate in the first assessment phases (25 % participation rate). They were divided at random in two groups: group 1 ( $n = 12$ ) started with a Luminette® period and group 2 ( $n = 13$ ) started with a period without Luminette®. Baseline for both groups was not significantly different for socio-demographic data, provided for the whole sample in Table 1. Average age was 36.5 years. Twenty one participants (84 %) were women, half of the participants were nurses (52 %). Most worked full time (76 %) in an office without window (96 %). Data for psychological measures at time 1 also appear in Table 1. On the Hamilton Depression Ratings Scale, (HDRS), average score obtained in the 25 item version taking seasonal symptoms into account was 7.5, meaning mild depression. Average scores on the Beck depression and anxiety indices (BDI et BAI) showed minimal depression and anxiety. On the sleep and sleepiness scales (PSQI et ESS), and average scores indicate sleep disturbance and sleep debt. In the health questionnaire de santé (SF36), the weakest results at time 1 were general mental health and vitality.

Fourteen employees participated in all assessment phases. No significant scoring difference was noted at time in the questionnaires between subjects who continued ( $n = 14$ ) and

**Table 1**

Sociodemographic and psychological data for participants at time 1 ( $n = 25$ ).  
Participants' characteristics ( $n = 25$ ).

	n(%)	Average (standard deviation)
<i>Socio-demographic characteristics</i>		
Age		36.6 (7.7)
Sex		
Male	4 (16)	
Female	21 (84)	
Profession		
Nurse	13 (52)	
Secretary	5 (20)	
Physician	5 (20)	
Doctor	1 (4)	
Psychologist	1 (4)	
Schedule		
Full time	19 (76)	
Part time	6 (24)	
Office		
No window	24 (96)	
Window	1 (4)	
<i>Psychological characteristics</i>		
Hamilton Depression Rating Scale (HDRS)		
Version à 17 items		4.1 (3.0)
Atypical items		3.4 (3.8)
25 item version		7.5 (5.6)
Beck Depression Index (BDI)		9.3 (9.1)
Beck Anxiety Index (BAI)		6 (5.4)
Pittsburgh Sleep quality index (PSQI)		5.3 (3.1)
Epworth sleepiness scale (ESS)		
Health questionnaire (SF36)		10.2 (5.3)
Physical function		
Physical problems	80.2 (29.5)	86.7 (21)
Pain		78.5 (25.7)
General health perception		71.8 (17)
Vitality	47 (24.6)	47 (24.6)
Social func.	79 (21.6)	79 (21.6)
Emotional problems	76.4 (34.7)	76.4 (34.7)
General mental health	59.3 (21.7)	59.3 (21.7)
General physical health	83 (21.7)	83 (21.7)

those who stopped ( $n = 11$ ). Reasons for stopping the use of Luminette® were multiple: negative side effects (e.g. migraines, nausea), decreased interest in the study, exclusion of pregnant women, and holidays (including Christmas).

#### 3.2. Effects of Luminette®

The scores for both groups were not different at each assessment time (e.g. assessing both groups after one month of using Luminette®), and comparative analyses of averages were made for the entire sample ( $n = 25$ ). T pairs were used to compare averages, as the number of subjects decreased as the study went on. Table 2 shows results for questionnaires for the entire group ( $n = 25$ ) at the four assessment times: T1, before using Luminette®; T2, after one month of using Luminette®; T3, after one month without using Luminette®; T4, after the second month of using Luminette®.

**Table 2**  
Effect of Luminette® (n = 25).  
Effects of light therapy with Luminette® (n = 25).

	Average (standard deviation)				Comparisons: T pairs t (p)		
	T1	T2	T3	T4	T1-T2	T1-T3	T1-T4
Depression (BDI)	8.3 (9,9)	3.5 (3.5)	3.4 (3.4)	2.5 (3.5)	2.05 (0.056)	2.01 (0.061)	2.28 (0.040)
Sleepiness (ESS)	10.2 (5.5)	6,9 (4,8)	6.4 (5.4)	6,9 (5,9)	2.17 (0.046)	2.42 (0.028)	1.64 (0.128)
SF36							
General p=Perception	63.8 (22.4)	80 (11)	81.1 (17,8)	81.3 (13,6)	-2.61 (0.026)	-2.15 (0.051)	-2.01 (0.068)
Physical func.	80 (30,2)	95 (8,8)	91.2 (15,9)	95 (8,6)	-2.36 (0.042)	-1.85 (0.089)	-1,93 (0.080)
Pain	74.5 (29,9)	77.3 (24,9)	86.7 (16,6)	87,9 (14)	-2.68 (0.023)	-2.23 (0.044)	-1.09 (0.299)
Emotional problems	82.1 (31,3)	89.7 (21)	98.1 (7,9)	89.6 (23,5)	-3.02 (0.013)	-2.25 (0.042)	-0.52 (0.611)

BDI: Beck Depression Index; ESS: Epworth sleepiness scale; SF36: short form health survey; T1, baseline; T2, after one month of using Luminette®; T3, after one month without using Luminette®; T4, after the second month using Luminette®.

The comparative analysis of averages has shown significant differences after one month of using Luminette® (T2) compared to the time prior to the use of Luminette® (T1) for daytime sleepiness measured on the ESS ( $t = 2.17$ ;  $p = 0.046$ ), general perceived health ( $t = -2.61$ ;  $p = 0.026$ ), physical functioning ( $t = -2.36$ ;  $p = 0.042$ ), pains ( $t = -2.68$ ;  $p = 0.023$ ) and professional limitations due to emotional problems ( $t = -3.02$ ;  $p = 0.013$ ) measured on the SF36. Slumber decreased, and general perceived health, physical functioning, pains and role limitations due to emotional problems significantly improved after one month of using Luminette®. One month later (T3), benefits were maintained without light therapy: daytime slumber ( $t = 2.42$ ;  $p = 0.028$ ), pains ( $t = -2.23$ ;  $p = 0.044$ ) and role limitations due to emotional problems ( $t = -2.25$ ;  $p = 0.042$ ). Some effects were significant again at 0.10 after the second period of using Luminette® (T4) compared to the baseline results (T1) for general health perception ( $t = -2.01$ ;  $p = 0.068$ ) and physical functioning ( $t = -1,93$ ;  $p = 0.080$ ). Furthermore, depressive symptoms decreased significantly after two months of light therapy ( $t = 2.28$ ;  $p = 0.040$ ).

Fig. 2 shows the positive evolution of depression levels (on the BDI) at different times throughout the sample.

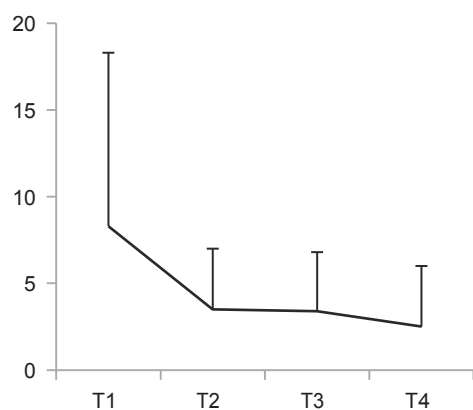


Fig. 2. Evolution of depressive symptoms throughout the sample measure by Beck Depression Inventory.

#### 4. Discussion

Our randomized cross-over study aimed at analysing the effects of light therapy through the use of Luminette® by healthy employees of a specific work place, namely a medical department without access to natural daylight. Out of the 100 members of the department of radiation therapy, 25 agreed to participate to the study. Prior to the use of Luminette®, results show sleep disturbances, general mental health problems and a lack of vitality.

The analysis of results shows that participants benefitted from the use of Luminette®. Indeed, the levels of daytime slumber significantly decreased and the general health perception, physical functioning, pains and role limitations caused by emotional problems significantly increased significantly increased after one month of use. One month later, benefits were maintained without light therapy for three variables: daytime slumber, pains and emotional problems. Some positive effects on perception of health and physical functioning appeared again after the first period of exposure to Luminette®. Furthermore, depressive symptoms significantly decreased after the two months of light therapy.

This study shows that the use of Luminette® could lead to positive results similar to those obtained from light therapy in other studies [7,8]. This study is the first validation of Luminette® and confirms that light therapy can have a positive effect on the well being and functioning in the workplace. Indeed, studies have shown that levels of depression and sleepiness, and more generally health, could have an impact on function in the workplace [5,19].

This study had certain limitations. First, the results must be considered with caution given the limited size of its sample. Second, there was probably a bias in participant selection from the start as participation was voluntary (positive expectation bias). Thirdly, another selection bias remains, as the subjects are healthy and do not take psychotropic medication.

In the future, it would be interesting to study the effect of Luminette® on performance efficiency with much more specific objective measures associated with the workplace. Most importantly, a strict method including randomization between a group using Luminette® and a group using a placebo Luminette® (e.g.: low intensity red light) could decrease doubts on its efficiency.

## 5. Conclusion

Repeated light exposure through the use of Luminette® in autumn-winter in a hospital department with no access to natural light had a positive impact on all participants, including those without seasonal depressive symptoms. Our data shows the interest of using Luminette® as a tool of light therapy. Future studies are necessary to duplicate such encouraging results on larger samples and verify its efficiency in a randomized study with one group using a placebo Luminette®.

## Declaration of interests

Authors declare not having any conflict of interest in relation with this article.

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