

Risk factors for computer visual syndrome (CVS) among operators of two call centers in São Paulo, Brazil

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Abstract: The aims of this study were to investigate work conditions, to estimate the prevalence and to describe risk factors associated with Computer Vision Syndrome among two call centers' operators in São Paulo (n = 476). The methods include a quantitative cross-sectional observational study and an ergonomic work analysis, using work observation, interviews and questionnaires. The case definition was the presence of one or more specific ocular symptoms answered as always, often or sometimes. The multiple logistic regression model, were created using the stepwise forward likelihood method and remained the variables with levels below 5% (p < 0.05). The operators were mainly female and young (from 15 to 24 years old). The call center was opened 24 hours and the operators weekly hours were 36 hours with break time from 21 to 35 minutes per day. The symptoms reported were eye fatigue (73.9%), "weight" in the eyes (68.2%), "burning" eyes (54.6%), tearing (43.9%) and weakening of vision (43.5%). The prevalence of Computer Vision Syndrome was 54.6%. Associations verified were: being female (OR 2.6, 95% CI 1.6 to 4.1), lack of recognition at work (OR 1.4, 95% CI 1.1 to 1.8), organization of work in call center (OR 1.4, 95% CI 1.1 to 1.7) and high demand at work (OR 1.1, 95% CI 1.0 to 1.3). The organization and psychosocial factors at work should be included in prevention programs of visual syndrome among call centers' operators.

Keywords: Call center; Visual fatigue; Risk factors; Occupational health; Computer visual syndrome

Introduction

Visual fatigue is an eye disorder that is studied because of its high prevalence and its increase in some activities [12, 17-18, 20, 25, 26] including the professionals who work with computer.

The occurrence of visual fatigue in professionals who use computers was first described in 1982 by Elias and Cail [21] whom considered it as a functional disorder, by excessive and prolonged contractions of the ciliary muscles of the eye, in order to obtain a fine focus objects. Blehm et al. [5], have defined the visual fatigue associated with computer work as Computer Vision Syndrome (CVS) that can be characterized by the presence of one or more eye symptoms (visual fatigue,

eye fatigue, burning sensation, eye irritation, "redness", "blurred vision" and "dry eyes").

The potential pathophysiological mechanisms of CVS were grouped by Blehm et al. [5] in three clusters of symptoms: **eye disorders:** local pain, burning sensation, feeling of "burning", changes in blinking frequency, excessive tearing and "dry eye"; **visual disturbances:** photosensitivity, difficulty focusing (blurred vision), double vision, persistent abnormal image after-image and instability in its optical and spatial definition; **general disorders:** headaches, migraines, back pain and/or neck pain, muscle spasms in the regions of the neck and shoulders, the latter requires the presence of other ocular symptoms.

The causes of CVS have been categorized by Blehm et al. [5] on intrinsic and extrinsic

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environmental and extrinsic eye. The intrinsic factors are mainly caused by the mechanism of eye accommodation. Two examples are of the refractive errors not properly corrected, or when there is the presence of ocular-motor group of phorias.

Extrinsic environmental factors include the lighting environmental conditions. Lighting in the workplace can be natural or artificial the latter consist of electric lamps, which can be fluorescent, incandescent, mercury or sodium [8].

Blehm et al. [5] considered as extrinsic eye factors: the decrease in the rate of flashing/blinking; the increase of exposure of the ocular surface; the use of contact lenses or medication; the presence of systemic or external eye diseases.

Piccoli [2] describes that the changes in work processes and the increase of the computers' use cause a need for an efficient visual systems. The association between visual disorders and psychosocial work factors is suggested by the idea that visual disturbances are related to the intensity and duration of visual requirements and to the work situation perceived by the employee and to the pathophysiological characteristics of the visual system of each individual [2].

The International Labour Organization [11] defines the psychosocial factors as the interaction of workers' perceptions and experience with aspects related to the work conditions and also the social system.

To explain the work stress and the impact on workers' health, the study adopted the model of Karasek and Theorell [22], known as the demand-control model that assumes that occupational stress can lead to diseases. According to Araujo [24], the model provides, from a combination of different levels of control and demand, four basic types of experiences at work: high-strain job (work situation characterized by high demand and low control), active work (situation of high demand and high control), passive jobs (low demand and low control) and low strain (combining low demand and high control).

The studies about the impact of work and vision have grown in the last years [2, 6, 12, 18]. One consequence was the creation of a specific scientific committee at the International Commission on Occupational Health defined as International Scientific Committee on Work and Vision. The document prepared by this committee concluded that the work-related eye disorders are multifactorial and may be associated with work activity, environmental conditions and ophtalmic individual characteristics [2]. According to the committee, the advance of research in this area should

provide workers with better visual conditions in the workplace, resulting in a better quality at work and higher productivity.

One professional that should be studied is the call center operator worker. The use of computers is consistently one of the characteristics of call center, which can be defined as an organizational structure that includes jobs for customer service through the use of a computer terminal and a telephone [13]. For Read [3], from the standpoint of health, the environment of call centers is considered medium to high risk and one health effect is the visual fatigue of workers.

According to Raab Glina and Rocha [7], the psychosocial aspects identified in the working conditions of the call center operators included: high quantitative and qualitative demands, with significant emotional, cognitive and physical loads, lack of control over work, the high volume of information to be dealt with, contradictory demands from the enterprise, based on a small average work time for each call and high quality services, and difficult in the relationships with customers.

The aims of this study are: investigate the working conditions and organization in call centers; to evaluate the prevalence of CVS, among call centers' operators and describe risk factors associated to work conditions and socio-demographic characteristics in two call centers of São Paulo - Brazil.

Methods

This study is a cross-sectional observational study and an ergonomic work analysis that were conducted in two call centers. It was approved by Ethics Committee from Medicine School and Public Health School of University of São Paulo. All participants were informed of the objectives and participated voluntarily in this study.

Study population

One call center was a central administrator of health plans (HPC), with 134 workers and the other was a booking center of an airline (ATC), with 397 workers. In total 476 questionnaires were filled: 125 of HPC and 351 of ATC. The reasons why the professionals did not participate in the study were: vacations, on maternity leave and absences. There were two cases of refusal.

Ergonomic work analysis

An ergonomic work analysis was conducted according to methodology developed by Guerin et al. [9]. This method is composed of five steps: analysis of the demand (consists of discussing and clarifying the problems to be solved); task analysis (everything that defines the work of each one, in a given structure); activity analysis (systemic analysis of the work behaviors); validation; diagnose and recommendations. There were a total of 26 technical visits to the call centers and each one had an average of 4 hours.

Questionnaire

In this project a structured questionnaire was applied, including questions about visual complaints, adapted by Elias and Cail [21]. Information collected were: socio-demographic, lifestyle habits, occupational history, work situation (conditions and work organization) factors of satisfaction and factors of fatigue or discomfort at work, psychosocial aspects and work-related health effects.

The factors of satisfaction and factors of fatigue or discomfort were based on the results of ergonomic work analysis.

The categorization of responses was composed by five alternatives: never, rarely, sometimes, often and always or great, good, fair, poor and bad.

The questionnaires were self-applied in different work schedule, and were filled during working times in a room near their activities. The mean time for filling out the forms was 40 minutes.

Data analysis

Data from observations and interviews were analyzed. Data from ergonomic work analysis provided a description of the activity of call center operators of each enterprise.

The distribution of all variables was described and also the distribution according to the presence of CVS with the absolute and relative frequencies (count and percentage). For each variable it was use the chi-square tests likelihood ratio and Fisher exact tests (bivariate tests) to define the level of association (p).

The eye symptoms were studied based on the division between visual and ocular symptoms described by Blehm et al. [5]. Oculars symptoms were: "burning" eyes and tearing. The visual symptoms were: eye fatigue, weight in eyes and weakened vision. In this study CVS were considered when operators answered the presence of ocular symptoms as always, often or sometimes. Operators who reported visual disturbances were excluded because these

symptoms were more general and related to the mechanism of accommodation.

A factor analysis was carried out to reduce the number of variables related with factors of fatigue or discomfort at work. The application of factor analysis allowed us to obtain factor scores to be used in the second phase, which corresponds to the application of multiple linear regression analysis. For this analysis, we used the program "Statistical Package for the Social Sciences" - SPSS - with sub-FACTOR, the factors extracted by the method of principal components with eigenvalues greater than 1.0.

Based on the Karasek and Theorell [22] model, the sum of the issues of requirements/demand at work with the higher the greater risk to stress. The sums of the issues of decision making authority, the discriminations tasks, the job security and the support from superiors and colleagues with the lower sum the greater risk to stress.

The multiple logistic regression model was created using the forward stepwise likelihood ratio method with the variables with significance levels in the bivariate tests below 20% ($p < 0.20$). The variables that remained in the final model were the ones with statistical significance levels below 5% ($p < 0.05$).

Results

The work of call centers' operators

The call center of the Health Plan Company was designed to provide information and guidance to 612.000 users. As well as, grant authorizations for medical and laboratorial procedures. The call center of the Air Transport Company had as its main activity booking and receiving calls from passengers and travel agencies, providing information on pricing, alternative routes and flight schedules, and making ticket reservations.

The call center workers activity of both centers consists on after establishing an early phone conversation with the client, search for information on computer screens and provide data and sometimes to enter data according to the reasons for the call. Workers remained in static setting posture 95% of the time.

In general, the operator had some guidance from the system to respond to customer issues. The complexity of the task was characterized by the diversity of clients and their needs, creating the search for consultation of documents, colleagues and supervisors, in order to fulfill the demand.

The call centers were opened 24 hours, including weekends and holidays, with four shifts: morning, afternoon, evening and night.

The operators weekly hours were 36 hours, six hours each day. They generally did not performed over time. The break during each work day was from twenty one to thirty five minutes.

The operators cited as factors related to fatigue or discomfort at work: pressure queue (clients who are waiting for telephone service), small number of breaks, lack of prospects for career advancement, uncooperative users that lengthens the duration of the call, being "seen and treated" as a machine and lack of recognition by the company.

Table 1
Distribution of call centers' operators and prevalence of CVS according to socio-demographic characteristics, lifestyle habits, domestic work and occupational history

Characteristics	Total		Prevalence		
	N*=476	%	N	%	P
Gender					< 0.001
Female	353	74.8	214	61	
Male	119	25.2	46	39	
Age (years)					0.136
15-24	223	46.8	132	59	
25-34	167	35.1	87	52	
35 or more	86	18.1	41	48	
Educational Level					0.340
High school	113	23.7	55	49	
College incomplete	216	45.4	121	56	
College complete	147	30.9	84	57	
Marital Status					0.888
Single	337	70.8	185	55	
Married	113	23.7	62	55	
Single/widowed	26	5.5	13	50	
Smoking					0.904
Never smoked	309	64.9	171	55	
Stopped smoking	52	1.9	28	54	
Regular smoker	69	14.5	35	51	
Casual smoker	46	9.7	26	57	
Alcohol intake					0.164
Non drinker	181	38.0	94	52	
Once a week	196	41.2	117	60	
More than once a week	99	20.8	49	49	
Physical activities					0.197
Yes	249	52.3	143	57	
No	227	47.7	117	51	
Domestic work					0.136
None	302	63.4	160	53	
Light work	152	31.9	86	57	
Heavy work	22	4.6	14	64	
Time at this function					0.165
From 03 to 12 month	142	29.9	70	49	
From 13 to 36 months	160	33.7	99	62	
From 37 to 60 months	75	15.8	42	56	
From 61 to 120 months	49	10.3	23	47	
121 months or more	49	10.3	25	51	
Time at this company					0.115
From 03 to 12 months	135	28.4	66	49	
From 13 to 36 months	144	30.3	91	63	
From 37 to 60 months	92	19.4	51	55	
From 61 to 120 months	44	9.3	22	50	
121 months or more	60	12.6	29	48	
Work shift					0.792
Morning	232	50.8	128	55	
Afternoon	170	37.2	92	54	
Evening/Night	55	12.0	28	51	
Time worked with VDT					0.295
Less than 1 year	53	11.1	29	55	
From 1 to 4 years	259	54.4	151	58	
From 5 to 9 years	87	18.3	43	49	
10 years or more	77	16.2	37	48	

P from X Square; Different amounts of total (475) are due to unanswered questions

Socio-demographic characteristics, lifestyle habits and occupational history

Table 1 showed that regarding social demographic characteristics, the operators were mainly female, young and had incomplete high education level. Regarding lifestyle habits, most were non smokers and used alcohol once a week. About occupational history, the predominant time in the company and at the function was from 13 to 36 months; the time working with video display terminal (VDT) was from 1 to 4 years. Most of the operators began their work in the morning.

Table 2
Distribution of call center operators and the prevalence of CVS according to work perceptions

Characteristics	Total		Prevalence		P
	N*=476	%	N	%	
Acoustic					0.596
Good	202	42.4	108	53.5	
Regular	151	31.7	80	53.0	
Bad	123	25.8	72	58.5	
Lighting					0.193
Good	303	63.7	159	52.5	
Regular	133	27.9	74	55.6	
Bad	40	8.4	27	67.5	
Temperature					0.169
Good	141	29.6	68	48.2	
Regular	175	36.8	98	56.0	
Bad	160	33.6	94	58.8	
Working tools					0.722
Good	257	54.0	140	54.5	
Regular	151	31.7	80	53.0	
Bad	68	14.3	40	58.8	
Space/Layout					0.762
Good	279	58.7	149	53.4	
Regular	97	20.4	56	57.7	
Bad	99	20.8	54	54.5	
Chair					0.920
Good	176	37.0	94	53.4	
Regular	143	30.0	79	55.2	
Bad	157	33.0	87	55.4	
Table					0.115
Good	272	57.1	150	55.1	
Regular	97	20.4	52	53.6	
Bad	107	22.5	58	54.2	
Number worker					0.115
Sufficient	117	24.6	175	58.1	
Unsufficient	301	63.4	55	47.0	
Unknown	57	12.0	30	52.6	
Training offered					0.181
Sufficient	313	65.8	90	60.4	
Unsufficient	149	31.3	164	52.4	
Unknown	14	2.9	6	42.9	
Job satisfaction					<0,001
Yes	266	55.9	124	46.6	
No	210	44.1	136	64.8	

P from X Square; Different amounts of total (475) are due to unanswered questions

Workers' perceptions about working conditions

Table 2 shows that the operators considered the acoustic and the lighting conditions, the space/layout, the table and the quality of instruments as good. The temperature was considered regular and the chair good and bad.

The number of existing employees in the area was considered insufficient and the training offered sufficient and job satisfaction (Table 2).

Repercussions on the visual system

The prevalence of CVS was 54.6% with 260 cases. The prevalence of ocular symptoms were: "burning" eyes 54.6% (95% CI, 51.6-60.6), and tearing 43.9% (95% CI, 39.4-48.3).

The prevalence of the visual symptoms were: eye fatigue 73.9% (95% CI, 69.9-77.8); weight in the eyes 68.2% (95% CI, 64.0-72.4) and weakened vision 43.5 (95% CI, 39.0-47.9).

Tables 1 and 2 show the prevalence of symptoms for each variable. The variables that were included in the logistic regression were: gender, age, alcohol intake frequency, intensity of domestic work, time working in the function, time working at that enterprise, lighting, temperature, number of workers in the area, training offered and job satisfaction.

The factor analysis resulted in the presence of four components: T1-recognition at work (lack of recognition by the company; lack of professional career; lack of autonomy at work; perception of internal environment as injustice, perceiving as being treated as machine); T2-evaluation process (system of performance evaluation, ISO 9000 by the company, being monitoring by the system and supervisor), T3-organization of work in call center (volume of information, multiplicity of clients, number of breaks, responsibility, queue pressure), T4-work post (lack of control, inadequate tools, uncomfortable posture, computer system). Univariate regression analysis indicated association of CVS and T1 and T3 (Table 3).

Table 3 shows the association between CVS and psychosocial factors. Univariate regression analysis indicated association between CVS and work demand, decision making authority, job security and support from superiors and co-workers.

Table 4 shows the variables that remained in the final multiple regression models. It was verified associations between: being female, lack of recognition at work, organization of work in call center and high demand at work.

Table 4
Final regression model of factors associated with CVS

Variables	OR	IC (95%)		P
		Inferior	Superior	
Gender-Female	2.58	1.62	4.13	<0.001
Lack of recognition at work - T1	1.42	1.14	1.76	0.002
Work organization in call center - T3	1.40	1.13	1.75	0.003
High work demand	1.13	1.01	1.27	0.041

Table 3
Comparison between CVS symptoms and psychosocial factors and factors of discomfort or fatigue at work

Variável	CVS	Av.	DP	Med.	Min.	Max	N	P
Work demand	No	4.14	2.05	4	0	9	215	0.001
	Yes	5.03	1.91	5	0	9	260	
Decision authority	No	4.05	1.93	4	0	8	215	<0.001
	Yes	3.42	1.98	3	0	8	260	
Task discrimination	No	2.71	1.43	3	0	6	215	0.491
	Yes	2.61	1.25	2,5	0	6	260	
Job security	no	2.77	1.34	3	0	6	215	0.023
	yes	2.50	1.38	2	0	6	260	
Social support	no	4.66	2.15	5	0	8	215	<0.001
	yes	3.99	2.00	4	0	8	260	
Factors		CVS						
T1- Work recognition	no	- 0.23	1.00				203	< 0.001
	yes	0.18	0.96				251	
T2- Evaluation process	no	- 0.04	1.02				203	0.491
	yes	0.03	0.98				251	
T3- Work organization	no	- 0.23	1.03				203	< 0.001
	yes	0.18	0.94				251	
T4- Work post	no	- 0.06	1.03				203	0.288
	yes	0.04	0.97				251	

*P from T-student test; Av.: Average; Med.: Medium; Min.: Minimum; Max.: Maximum

Discussion

This study verified a high prevalence of computer visual syndrome among call centers' operators. The presence of CVS was associated with being female, lack of recognition at work, the organization of work in call centers and high demand at work.

Regarding the prevalence, Sanchez-Roman et al. [10] analyzed the frequency of asthenopia in call centers' operators in Mexico, using a questionnaire and eye examination verifying a higher prevalence: 68.5%. This higher prevalence could be explained because there was an ophthalmologist evaluation. Considering the ocular symptoms the prevalence of "burning" eyes was 51.4% and tearing was 37.1% similar that obtained in this study.

In India, Bhanderi et al. [6] analyzing 419 operators who worked using the computer found a prevalence of 46.3% of asthenopia. This result can be explained because they used the computer but they were not call centers' operators that remained sit in front of the terminal during all journey.

The association observed between the presence of CVS and being female was also observed by Rocha and Debert-Ribeiro [12] that studied the systems analysts and visual fatigue.

In this study we did not observe association between CVS and environmental conditions that could be explained because the call centers' operators considered the lighting as good. On the contrary, Raab Glina and Rocha [7], while studying call centers' operators at a bank in Sao Paulo, found complaints about the lighting that was weak at night.

The lack of recognition at work which was observed in this study as associated with CVS included the lack of professional career and autonomy at work and the perception to being treated as a machine.

In this study we verified that the activity of operators in call centers involves high mental work demands (cognitive and emotional) with low autonomy. Considering the demand-control model by Karasek and Theorell [22], we can describe the call center operator activity as a high strain job. This result was also observed by Toomingas et al. [1] in Swedish call centers.

The association observed between CVS and the lack of control was also studied by Vilela and Assunção [15] that detailed the mechanisms of control used by a call center of an enterprise of telephony demonstrating the intense control of their work. They had the control of the time of each call, the words that had to be used (script), the time that they were in pauses, the volume and the results at work.

Regarding the perception of being treated as a machine, it was also observed by Sznelwar and Massetti [14] that studied call centers' operators in a financial enterprise and described that even though they spent all the time communicating with customers, they felt that in many situations, they are using the vocal tract and brain but the standardizations established by the organizers of the work generated the complaint of being "seen or treated" like a machine.

In the study we observed an association between CVS and how is the organization of work in call center with high volume of information, variety of demands from clients with different cultures, small number of breaks and high responsibility.

Rocha et al. [13] explained that call center operators activity integrates the computer work hazards to risk related to the telephone operator's work. Computer work's hazard like static posture as a consequence of the characteristic of the workstation which required constant sitting posture, with the vision directed to the screen and the attention distributed between the screen and headset; inadequate furniture and repetitive motions. The risks associate with telephone operators were: an extreme prescription of work, the call time pressure associated to the monitoring of the quality of customer service, routine work, low job control and the presence of psycho affective

demands related to the interaction with the customers.

One important factor was the "pressure of the queue" factor represented by the number of customers waiting to be served also observed by Raab Glina and Rocha [7].

Another characteristic of work organization in call center activity observed by Fernandes et al. [23]: the existence of "bonus" awards for individual productivity resulting in a competitive job.

In this study we observed an association between CVS and high demand among call centers' operators work. This results are similar with Sanchez-Roman et al. [10] that described that asthenopia was associated with working more than four hours in front of the video terminal. Ghassemi-Broumand and Ayatollah [16] also verified more ophthalmic complications between workers that use computer for more than 4 hours.

This study highlights the need for action to change work environment conditions and work organization, to analyze professional activity at call centers and at the same time, of workers characteristics. For Costa and Kara-Jose [19], the promotion of eye health is necessary to ensure a good quality of life: the individual must have visual ability that allows the development of their capabilities and their participation in society.

According to the Committee of the International Commission of Health, the current way of dealing with the issues of "work and vision" is still isolated, for example, eye exams performed by ophthalmologists, lighting designed by engineers and architects, chemical pollution studied by occupational hygienists. Because of the complexity of the relationship about work and vision, these actions are limited and ineffective in protecting workers' health.

Regarding the legislation to prevent CVS, the European Economic Community (EEC), through its Council, published on May 29, 1990 the Directive No. 90/270/EEC about health and safety related to VDT (video display terminal) work that includes preliminary ergonomic assessment of workplace by the employer and eye exam before starting work and tests performed periodically.

In England, the Ministry of Work through the Health & Safety Executive/Local Authorities Enforcement Liaison Committee (HELA), published a recommendation (Advice Regarding Call Centre Working Practices) in December 2001, including the following aspects about the visual health of the operators: regulation of contrasting screen; breaks for visual rest and regular eye exams.

In Brazil, only in March 2007, The Ministry of Work and Employ published an Ergonomic

Guideline to call center activity that indicates ergonomic work analysis to better define the performance of the tasks and prevention of visual symptoms [4].

In this study, ergonomic work analysis was important to construct the questionnaire about the relation between work and health. The factors related with work organization were identified by this ergonomic analysis.

The main limitation of this study was that it was a cross-sectional epidemiological design, not allowing inferences of causality. In addition, this study involved only two call centers, not including workers who were removed for reasons of health. This study did not include the eye exams of the operators. On the other hand, this research adds to the literature data about specific factors associated with visual symptoms among call centers' operators.

Conclusions

The results demonstrated the importance of studying the CVS among call centers' operators and that there is an association between the symptoms and working conditions. The program of prevention of CVS should include eye examination periodically among the call centers' operators and the design of the work should take account psychosocial and organizational factors.

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