ORIGINAL ARTICLE

Working conditions, visual fatigue, and mental health among systems analysts in São Paulo, Brazil

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Aims: To evaluate the association between working conditions and visual fatigue and mental health among systems analysts living in São Paulo, Brazil.
Methods: A cross sectional study was carried out by a multidisciplinary team. It included: ergonomic analysis of work, individual and group interviews, and 553 self applied questionnaires in two enterprises. The comparison population numbered 136 workers in different occupations.
Results: The study population mainly comprised young males. Among systems analysts, visual fatigue was associated with mental workload, inadequate equipment and workstation, low level of worker participation, being a woman, and subject's attitude of fascination by the computer. Nervousness and intellectual performance were associated with mental workload, inadequate equipment, work environment, and tools. Continuing education and leisure were protective factors. Work interfering in family life was associated with mental workload, difficulties with clients, strict deadlines, subject's attitude of fascination by the computer, and finding solutions of work problems outside work. Family support, satisfaction in life and work, and adequate work environment and tools were protective factors. Work interfering in personal life was associated with subject's attitude of fascination by the computer, strict deadlines, inadequate equipment, and high level of work participation. Satisfaction in life and work and continuing education were protective factors. The comparison population did not share common working factors with the systems analysts in the regression analysis.
Conclusions: The main health effects of systems analysts' work were expressed by machine anthropomorphism, being very demanding, mental acceleration, mental absorption, and difficulty in dealing with emotions.

Use of computers in Brazil started during the 1970s. Since then there has been a large increase of workers whose major task is computer related. Among professions that have grown in importance and number in the past decade is systems analysis, which involves continuously transforming existing languages into other more modern ones, as well as turning manual operations into computer systems. Programming the machine has lead to the development of a specific relationship between the professional and the equipment.

Few studies[1–3] have focused on the health consequences of analysts' work. The study carried out by the National Institute of Occupational Safety and Health[1] involved supervisors and systems analysts. Positive aspects found were: worker satisfaction; feeling that the machine was not only a tool but also a source of amusement; time flexibility; and the dynamic nature of the work. Negative aspects included troubled interpersonal relationships with superiors and quality of the equipment. Lack of availability of the terminal and slow response time of the system made it difficult meeting deadlines.

Fugikaky[2] pointed out the importance of mental workload among software engineers, mainly in the phase of system implementation; at that time professionals declared themselves as physically and mentally exhausted. Kawakami and colleagues[3] studied the effects of work stressors on software engineers and programmers, observing that work overload and working conflicts were associated with depression and anxiety. Support from colleagues and ability in using the computer acted as protective factors.

In Brazil, Merlo[4] studied systems analysts of a data processing enterprise, observing that these professionals are under severe pressure from meeting strict production deadlines, management of the relationship with clients, and the fast changes undergone by computing products.

The present study was requested from the Ministry of Labor by the Processing Data Enterprises Employees' Union because of the lack of information on systems analysts' working conditions in Brazil. It provided elements for the collective agreement between systems analysts and employers.[5]

The study aimed to evaluate possible associations between working conditions and visual fatigue, mental and psychosocial health of systems analysts.

The study was intended to contribute to the understanding of mental health and psychosocial dimension of systems analysts as well as to clarify possible relationships between work and life outside work.

METHODOLOGY

The present investigation was a cross sectional study integrating qualitative and quantitative approaches designed and undertaken by a multidisciplinary team.

Qualitative assessment

The script of the semi-structured interview included life and work history, life conditions, leisure time and family organisation, detailed description of current work, health status, and workers' expectations. The collective interviews were undertaken at the worksite. Individual interviews were carried out at the interviewee's home, aiming to determine the relationship of the worker to his family. The interviewer was a social scientist trained in occupational health. Seventeen workers were interviewed. Median duration of the interview was three to four hours. Interviews were taped and transcribed.

Main messages

- Visual fatigue was associated with mental workload, inadequate equipment and workstation, and low level of worker participation at work.
- Mental and psychosocial health aspects were associated with mental workload, difficulties with clients, strict deadlines, inadequate equipment, and work environment.
- The main health effects were expressed by machine anthropomorphism, being very demanding, mental acceleration, mental absorption, and difficulty in dealing with emotions.
- Psychosocial aspects identified as specific by systems analysts were related to the kind of relationship with the computer.
- Satisfaction in life and work was an important protective factor against mental and psychosocial health effects of systems' analysts work.

Policy implications

- Occupational guidelines for systems analysts should incorporate not only environmental conditions, workroom, and equipment issues but also work organisation and psychosocial aspects.
- As computer programming is extended it becomes important to acknowledge mental and psychosocial health issues for these professionals.
- Systems analysts should be involved in elaboration and implementation of occupational health policies.

The assessment of working conditions was based on the ergonomic analysis of the workplace including the observation of the workstation, environment, equipment, and work organisation. It was carried out by a professional trained in ergonomics according to Guerin's methodology.[6]

Quantitative evaluation

Study population

The study was carried out in two data processing enterprises, one state owned with 347 professionals and one belonging to a private bank with 398 employees. In the latter, 341 (85.6%) analysts participated, whereas in the state agency 295 (85.0%) were included. Non-participation was due to vacation time, meetings with clients outside the worksite, training abroad, maternity leave, and absences. There were nine cases of explicit refusal. The total sample comprised 636 systems analysts in the two enterprises.

A comparison population was selected among professionals of the same enterprise with similar wages. The objective of the procedure was to have a group for which life conditions were very similar to those of systems analysts. The comparison group was selected only in enterprise one, which graded occupations according to wage categories. The need to ensure salary comparability precluded the selection of a comparison group in enterprise two, as systems analysts' salary level would only match those of managers from other enterprises pertaining to the financial group.

Programmers, data entry operators, and computer operators were excluded from the comparison population due to their specific relationship with the computer.

The comparison population comprised 215 workers, of which 147 (68.4%) participated in the study. Reasons for non-participation of subjects in the comparison population were the same as for systems analysts. There were 15 cases of refusal.

Questionnaire

A careful literature review of questionnaires related to video display terminal work,[7] stress[8] and hypertension research[9] was carried out. Elements of semi-structured interviews and the assessment of working conditions, were also incorporated in the questionnaire. The questionnaire was tested with 10 systems analysts to evaluate understanding, and adequacy of contents. Due to the long time spent in filling out the questionnaire, the decision was made to split the original instrument into two forms.

Self administered questionnaires were used; non-identification of subjects was guaranteed. The worksites were initially visited by the research team. At that time workers were informed of the objectives of the study and informed consent was requested. The questionnaires were filled in during working hours and with managers' consent.

Form one addressed social and demographic information such as gender, schooling, marital status, number of children, leisure activities, health, and morbidity. The required time for filling in was 15–20 minutes. On that occasion three consecutive blood pressure measurements were taken with a mercury manometer after a 10 minute rest in the sitting position.

The second form, distributed on the following day, contained information on occupational history, working conditions that might generate distress and fatigue as well as work satisfaction, and personal and family life. The questionnaire items are given in the results section. Items were coded as always, frequently, sometimes, seldom, and never. Job satisfaction was given by self attribution. Filling in of this form took 30–40 minutes.

Splitting the questionnaire in two forms reduced the amount of time spent in filling it in each day. On the other hand, it increased the number of non-respondents to one of the forms. A total of 636 participants answered at least one of the forms and 553 filled in both forms: 306 (90%) were in the private owned firm and 247 (84%) in the state owned. For the comparison population 136 (92%) filled in both forms.

Data analysis

Three sets of data were considered: working conditions, health aspects, and correlates of work and health. The latter ones were variables that were neither part of working conditions nor of health aspects. Family support, satisfaction in life, social and demographic characteristics were among them.

Factor analysis was carried out to reduce the number of variables and determine the basic dimensions by selecting factors based on their importance in the explanation of phenomena. Factor rotation was based on the Varimax method and only variables with factor loads greater than 0.40 were considered. The analysis was carried out with subprogram Factor of the SPSS (Statistical Package for the Social Sciences) Program.[10] Factors were extracted by means of the principal components method, with values higher than 1.

In the factor analysis for the systems analysts, working conditions put together 87 variables from which 27 factors were extracted. Percentage of the total common variance was accounted for by 61.5%. From these, 13 were selected for the regression analysis. The second group of health aspects totalled 84 variables, from which 27 factors were extracted (total variance 63.3%), 12 factors being used in the

regression. The third group corresponded to correlates of work and health variables; it grouped 63 variables into 24 factors (total variance 62.1%), 13 factors being selected for the regression analysis.

For the comparison population, for working conditions there were 78 variables, resulting in 26 extracted factors (total variance 76.2%); 13 factors were selected for regression analysis. The second group included 80 variables on health aspects; 22 factors were extracted (total variance 75.2%), 12 factors being selected for regression analysis. Correlates of work and health factors grouped 62 variables, resulting in the extraction of 23 factors (total variance 72.6%), 14 of which were selected for regression analysis.

For the presentation of results of factor analysis, factors selected for each group of variables are shown. Moreover, proportion of variance explained by the given factor, the proportion of variance regarding the chosen factors, and the sum of squares are presented. Variables included in each factor as well as their loads, or the weight associated with the factor will only be provided for those selected for the multiple regression analysis.

Independent variables of regression analysis were factors regarding working conditions and correlates of work and health. Dependent variables were health aspects factors. Stepwise multiple regression[11] was used with a forward strategy. According to this technique variables were introduced one by one until a predefined significance level of 0.05. Factors were selected for presentation on the basis of the amount of variance explained by them for systems analysts factor analysis. In regard to the comparison population the same health aspects were considered. Regression tables provided the degree of explanation (R), B values, their standard errors, and F values. The fit of the model was checked via case wise diagnostic statistics by Stata v. 6.0 software.[12]

RESULTS

Social and demographic characteristics

Table 1 shows that the sample of systems analysts included a larger number of subjects that were younger, more educated, and with less children when compared to the comparison population.

Working conditions

The production process in computing services is made up of information treatment on customers' demands. The systems analyst is the one to whom the customer will request a given product, and who will also be in charge of the follow up of the services and their operational detailing. This means that the systems analysts are the link between the customer and the data processing enterprise. The task of the analyst was described by one of them as ''an invisible work'', taking the shape of documents and reports as final products.

The comparison population included managers (32.1%), human resources analysts (23.7%), finance analysts (25.2%), and technicians (19.0%).

Table 2 shows the factors related to systems analysts' working conditions. Factors selected for presentation are: $W_{3–7}$, W_9, $W_{11–12}$.

The third factor (W_3) grouped variables related to distress associated with time demands: deadlines (0.53), work overload (0.58), and irregular work schedules (0.44). Deadlines were related to the political and social impact of the product (0.57), work intensity (0.48), and pressure from clients (0.44).

The fourth (W_4) put together variables of distress associated with mental workload: constant work of the mind (0.85), thinking in detail (0.84), and high level of responsibility (0.63).

The fifth factor (W_5) was represented by workers' participation in technical (0.70) and administrative (0.69) decisions, as well as in work planning (0.67).

Table 1 Systems analysts and comparison population: gender, age group, schooling, marital status, and number of children

	Systems analysts		Comparison population		
Social and demographic characteristics	**n**	**%**	**n**	**%**	**p**
Gender					NS
Males	328	(59.3)	71	(52.2)	
Females	225	(40.7)	65	(47.8)	
Age (years)					**
<0.001					
18–24	60	(10.8)	1	(0.7)	
25–34	262	(47.4)	62	(45.6)	
35–44	184	(33.2)	56	(41.1)	
45–56	47	(8.5)	17	(12.5)	
Schooling					***
College (complete)	465	(84.1)	92	(67.7)	
College (incomplete)	72	(13.0)	25	(18.4)	
High school (complete)	16	(2.9)	14	(10.3)	
Elementary school	–	–	5	(3.7)	
Marital status					NS
Single	201	(36.3)	37	(27.2)	
Married	330	(59.7)	90	(66.2)	
Divorced/widow	22	(4.0)	9	(6.6)	
Number of children					***
None	287	(51.9)	52	(38.2)	
One	60	(10.8)	41	(30.1)	
Two	127	(23.0)	34	(25.0)	
Three or more	79	(14.3)	9	(6.6)	
Total	553	(100)	136	(100)	

χ^2. NS, not significant. **p<0.001, ***p<0.0001.

Table 2 Factors related to working conditions: systems analysts

Factors (W)	Proportion of variance explained (%)*	Proportion of factors chosen	Sum of squares
Work satisfaction: capacity of enterprise, acknowledgement, no routine work, creativity (W_1)	9.39	22.27	2.957
Relationship with superiors: support (W_2)	16.51	16.88	2.680
Distress: deadlines, work overload, irregular work schedules (W_3)	20.42	9.27	2.474
Distress: mental workload, responsibility (W_4)	23.65	7.66	2.446
Workers' participation (W_5)	26.34	6.38	2.255
Workstation: good (W_6)	28.71	5.62	2.155
Work environment and tools: good (W_7)	30.99	5.41	2.065
Career: adequate in private firm and not adequate in public firm (W_8)	33.06	4.91	2.005
Distress: equipment (W_9)	34.99	4.58	1.960
Job requirements: initiative, decision, plans (W_{10})	36.85	4.41	1.944
Continuing education: sufficient (W_{11})	38.66	4.29	1.912
Relationship with clients: difficult (W_{12})	40.44	4.22	1.813
Relationship with colleagues: support (W_{13})	42.16	4.08	1.784
Total		99.98	

*Cumulated frequency.

The sixth factor (W_6) characterised the good quality of furniture, such as chairs (0.77) and table (0.65), leading to less fatigue due to uncomfortable posture (0.63).

Work environment factor (W_7) comprised adequate lighting (0.69), temperature (0.71), and noise (0.53) as well as good quality of working tools (0.41) and of the video terminal display image (0.48).

Table 3 Factors related to working conditions: comparison population

Factors (Wc)	Proportion of variance explained (%)*	Proportion of factors chosen	Sum of squares
Furniture, environment and equipment: good (Wc_1)	10.02	18.32	4.599
Distress: work overload, client and colleagues (Wc_2)	18.22	14.99	2.833
Relationship with superiors and colleagues: support (Wc_3)	24.70	11.85	2.805
Workers' participation (Wc_4)	28.77	7.44	2.765
Work requirements: decision and responsibility (Wc_5)	32.83	7.42	2.601
Continuing education: sufficient (Wc_6)	36.32	6.38	2.424
Distress: equipment (Wc_7)	39.42	5.67	2.372
Work satisfaction: enterprise capacity (Wc_8)	42.39	5.43	2.194
Work satisfaction: acknowledgement, no routine work (Wc_9)	45.08	4.92	2.077
Work requirements: memory, planning (Wc_{10})	47.67	4.73	2.061
Expectation to change of professional area (Wc_{11})	50.14	4.51	2.029
Solution of work problems outside work (Wc_{12})	52.50	4.31	1.955
Career: lack of satisfaction (Wc_{13})	54.70	4.02	1.954
Total		99.99	

*Cumulated frequency.

Equipment (W_9) was rated as a distress factor due to insufficient number of terminals (0.64), presence of obsolete equipment (0.65), and the frequency of breakdowns (0.47).

Factor W_{11} included continuing technical education (0.71), human relationships education (0.67), and extra job dates (0.47).

Relationship with clients (W_{12}) was evaluated as negative because the latter were not able to inform their needs clearly (0.80) and did not acknowledge the difficulty involved in the systems analysts' work (0.75).

Table 3 shows the factors related to comparison populations' working conditions. Factors selected for presentation were: Wc_1, Wc_7, Wc_{12}.

The first factor (Wc_1) joined together variables related to the workstation perceived as positive by the comparison population: furniture, including table (0.82), chair (0.71), and layout (0.67); environmental conditions: temperature (0.76), noise (0.75), and lighting (0.67); working instruments (0.76) and the quality of video displays (0.62).

Factor 7 (Wc_7) gathered variables related to the equipment. Longer working periods at the computer (0.69) corresponded to higher frequency of complaints that the equipment is a factor of distress (0.78), the presence of filter screen (0.59), and uncomfortable posture (0.57).

Factor 12 (Wc_{12}) involved resolution of work problems while having a shower (0.73) and not in transportation (0.60).

Table 4 shows the factors related to health aspects of systems analysts. Factors selected for presentation were: H_1, H_2, H_4, H_5.

The first factor was visual fatigue (H_1), including the following symptoms: eye tiredness (0.77), sensation of weight in the eyes (0.72), reduced visual acuity (0.72), eye burning (0.66), and visual fatigue (0.56).

Factor 2 (H_2) contained variables such as nervousness and intellectual performance: difficulty to focus (0.80), unstable attention (0.72), memory problems (0.69), irritability and nervousness (0.48).

Factor 4 (H_4) included work interfering in family life: getting home and wishing for nothing else than watching TV (0.79), not being able to "turn off" the mind from work (0.59), feeling that subject's family does not follow his/her reasoning (0.74), and getting home very tired (0.69).

Table 4 Factors related to health aspects: systems analysts

Factors (H)	Proportion of variance explained (%)*	Proportion of factors chosen	Sum of squares
Visual fatigue (H_1)	14.59	35.31	2.902
Symptoms: nervousness and intellectual performance (H_2)	17.81	7.79	2.758
Search for medical care in the last 15 days (H_3)	20.94	7.57	2.363
Work interfering in family life (H_4)	23.77	6.85	2.347
Work interfering in personal life (H_5)	26.45	6.48	2.208
Mental fatigue and exhaustion (H_6)	28.93	6.00	2.182
Sleep disorders and work (H_7)	31.39	5.95	2.077
Backache and neck ache (H_8)	33.61	5.37	2.014
Symptoms: palpitation/chest pain (H_9)	35.68	5.01	1.993
Appetite disturbance (H_{10})	37.67	4.82	1.847
Normal blood pressure (H_{11})	39.56	4.57	1.833
Fatigue (H_{12})	41.32	4.26	1.748
Total		100	

*Cumulated frequency.

Table 5 Factors related health aspects: comparison population

Factors	Proportion of variance explained (%)*	Proportion of factors chosen	Sum of squares
Psychosomatic symptoms: nervousness, digestive and sleep disorders (Hc_1)	21.34	36.29	13.392
Backache, neck ache, and mental fatigue (Hc_2)	27.97	11.28	2.595
Work interfering in family life (Hc_3)	33.07	8.67	2.579
Search for medical care in the last 15 days (Hc_4)	37.55	7.62	2.553
Relationship with the computer (Hc_5)	40.92	5.73	2.548
Symptoms: cramp, dizziness (Hc_6)	43.92	5.10	2.430
Physical Fatigue (Hc_7)	46.87	5.02	2.399
Work interfering in personal life (Hc_8)	49.57	4.59	2.331
Hospitalisation and sick leave due to stress (Hc_9)	52.04	4.20	2.151
Visual fatigue (Hc_{10})	54.37	3.96	2.138
Normal blood pressure (Hc_{11})	56.65	3.88	2.033
Sleep disorder and work (Hc_{12})	58.80	3.66	2.015
Total		100	

*Cumulated frequency.

Factor 5 (H_5) included work interfering in personal life: systems analyst being very demanding and expecting everything to be correct (0.83), being rigid and meticulous (0.78), expecting people to act as accurately as does a computer (0.52), and being annoyed at any sort of delay (0.40).

Table 5 shows the factors related to health aspects of comparison population. Factors selected for presentation were: Hc_1, Hc_3, Hc_8, Hc_{10}.

Table 6 Correlates of work and health factors: systems analysts

Factors	Proportion of variance explained (%)*	Proportion of chosen factors (%)	Sum of squares
Family situation: married with children (I_1)	8.01	19.10	3.383
Professional experience: young (I_2)	12.32	10.28	2.190
Expectations as to professional change (I_3)	16.03	8.85	1.969
Satisfaction in life and work (I_4)	19.24	7.65	1.781
Women/lower body mass index (I_5)	22.20	7.06	1.727
Leisure: hobby, sports, arts (I_6)	24.98	6.63	1.725
Leisure: shopping; travel; TV/video; sleep (I_7)	27.71	6.51	1.708
Solution of work problems outside work (I_8)	30.31	6.20	1.595
Sleep and time commuting for work (I_9)	32.87	6.10	1.499
Family as support (I_{10})	35.22	5.60	1.488
Leisure: reading and video/ no household fixing (I_{11})	37.51	5.46	1.487
Reason for choice profession (I_{12})	39.76	5.37	1.459
Relationship with computers: challenge (I_{13})	41.93	5.17	1.440
Total		100	

*Cumulated frequency.

Factor 1 (Hc_1) put together psychosomatic symptoms: palpitation (0.87), chest pain (0.80), trembling (0.79), sweating (0.76), irritability (0.79), anxiety (0.76), depressive states (0.75), memory problems (0.76), difficulty to focus (0.80), unstable attention (0.73), lack of orientation in time (0.71) and space (0.79), nausea and vomiting (0.84), stomach overloading (0.78), constipation and diarrhoea (0.81), dreams about work (0.80), stormy nights (0.79), sleeplessness (0.74), and lack of sexual interest (0.74).

Factor 3 (Hc_3) showed work interfering in family life: getting home and wishing nothing else than watching TV (0.79), not being able to ''turn off'' the mind from work (0.68), feeling that subject's family does not follow his/her reasoning (0.63), and getting home very tired (0.61).

Factor 8 (Hc_8) included work interfering in personal life: being very demanding and expecting everything to be correct (0.79); being rigid and meticulous (0.73), and being annoyed at any sort of delay (0.45).

Factor 10 (Hc_{10}) showed visual fatigue (0.84) and eye tiredness (0.60).

Table 6 shows the correlates of work and health factors of systems analysts. Factors selected for presentation were: $I_{4–6}$, I_8, I_{10}, I_{13}.

The fourth factor (I_4) included satisfaction with work (0.70), satisfaction with life (0.72), and renewed option for the same work (0.42).

The fifth factor (I_5) was associated with being a female (0.70) and having lower body mass index (0.75).

Factor 6 included dedication to hobbies (0.74), sports (0.66), and arts (0.47).

Factor 8 (I_8) included resolution of work problems while having a shower (0.65) and during sleep (0.53).

The family as a factor of emotional support for facing difficulties at work (0.75), and little time spent with the family (0.60) were included in factor 10 (I_{10}).

Factor 13 (I_{13}) included variables concerning the relationship with the computer: fascination for the constant challenges it provides (0.75) and interpersonal relationships seen as easier with people of the same professional area (0.44).

Table 7 shows the correlates of work and health factors of the comparison population. Factors selected for presentation were: I_3, I_5, I_7, I_8, I_{10}.

Table 7 Correlates of work and health factors: comparison population

Factors	Proportion of variance explained (%)*	Proportion of factors chosen (%)	Sum of squares
Family situation: married with children (Ic_1)	7.40	13.63	3.351
Expectation of professional change (Ic_2)	13.54	11.31	2.659
Computer at home (Ic_3)	19.10	10.24	2.288
Professional choice (Ic_4)	23.33	7.79	2.095
Relationship with computer (Ic_5)	27.52	7.72	2.051
Solution of work problems outside work (Ic_6)	31.12	6.63	1.932
Leisure: shopping, travel (Ic_7)	34.64	6.49	1.927
Short time in the job (Ic_8)	37.80	5.82	1.914
Young professionals (Ic_9)	40.88	5.67	1.891
Leisure: TV, video (Ic_{10})	43.81	5.40	1.825
Satisfaction in life and work (Ic_{11})	46.60	5.14	1.812
Leisure: hobby/sports (Ic_{12})	49.33	5.03	1.802
Lower schooling (Ic_{13})	51.88	4.70	1.790
Male boss (Ic_{14})	54.27	4.40	1.783
Total		100	

*Cumulated frequency.

Table 8 Regression on visual fatigue

Variables (factors)	B	SE B	Sig T	R^2
Systems analysts: visual fatigue (H_1)				
Distress: mental workload (W_4)	+0.2106	0.0414	0.0000	0.0525
Workstation: good (W_6)	−0.1773	0.0407	0.0000	0.0898
Women/lower body mass index (I_5)	+0.1519	0.0406	0.0002	0.1195
Distress: equipment (W_9)	+0.1333	0.0412	0.0013	0.1360
Workers' participation (W_5)	−0.1106	0.0412	0.0075	0.1457
Relationship with computers (I_{13})	+0.0889	0.0404	0.0279	0.1534
F=16.07 n=538 df=6 p<0.0001 A (constant) = +0.0003504				
Comparison population: visual fatigue (Hc_{10})				
Relationship with computer (Ic_5)	+0.2252	0.1073	0.0381	0.0388
F=4.40 n=109 df=1 p<00381 A(constant) = −0.02558				

Factor 3 (Ic_3) included having a computer at home for extra work (0.93) or because of the children (0.92).

Factor 5 (Ic_5) was related to the computer: fascination by the constant challenges it provided (0.84) and its predictability (0.82).

Leisure activities in factor 7 (Ic_7) included travelling (0.77) and going shopping (0.65). Factor 10 (Ic_{10}) encompassed watching TV (0.74), video (0.42), and other activities (0.47).

Factor 8 (Ic_8) is made out of short time both in current job (0.76) and enterprise (0.42) and being born in São Paulo (0.55).

Regression analysis

Table 8 shows that among systems analysts, visual fatigue was associated with mental workload, inadequate equipment, and being a woman. Lower occurrence of visual symptoms was associated with adequate furniture and greater workers' participation at work. The only factor associated with visual fatigue for both systems analysts and the comparison population was subjects' attitude of fascination in the face of the constant challenges provided by the computer.

Regression analysis for systems analysts in table 9 showed higher frequency of nervous symptoms and change in intellectual performance as associated with distress factors: mental workload and equipment features. Factors that reduce the frequency of those symptoms were: work and life satisfaction, hobbies, sports and artistic activity; continuing education felt as sufficient, adequate work environment, and tools. Among the comparison population, the symptoms of psychosomatic disorders were associated with the presence of equipment as distress factor, adequate furniture and work environment, and having a computer at home. Factors that reduced symptoms were leisure factors such as: shopping, travelling, watching TV, and video.

Table 10 shows that among systems analysts, work interfering in family life was associated with mental workload, strict deadlines, difficulty when dealing with clients, inadequate work environment and tools, finding out solution of work problems outside, and the fascination exerted by the computer. Family's emotional support, work and life satisfaction provided protection against the influence of work on family life. For the comparison population work interfering in family life was associated with having a computer at home and short time both in the job and enterprise.

Among systems analysts, work interfering in personal life was associated with strict deadlines, inadequate equipment, difficulty when dealing with clients, greater workers' participation at work, and the fascination exerted by the computer. Factors that reduce the interference of work in personal life were work and life satisfaction and continuing education seen as sufficient. For the comparison population work interfering in personal life was associated with short time both in the job and enterprise, and finding out solutions of work problems outside work (table 11).

DISCUSSION

The present study detected associations between systems analysts' work with visual fatigue, mental, and psychosocial health. The comparison population was important because it showed that work factors associated with health aspects were different for both groups. In the comparison population, only psychosomatic symptoms were associated with working conditions.

Table 9 Regression analysis on nervousness and intellectual performance

Variables (factors)	B	SE B	Sig T	R^2
Systems analysts (H_2): nervousness and intellectual performance				
Satisfaction in life and work (I_4)	−0.2340	0.0401	0.0000	0.0851
Distress: mental workload (W_4)	+0.1959	0.0407	0.0000	0.1394
Distress: equipment (W_9)	+0.1425	0.0400	0.0004	0.1604
Continuing education: adequate (W_{11})	−0.1222	0.0409	0.0029	0.1782
Work environment/tools: good (W_7)	−0.1063	0.0399	0.0079	0.1884
Leisure: hobby, sports, arts (I_6)	−0.0876	0.0394	0.0267	0.1958
F=21.59 n=538 df=6 p<0.0001 A (constant) = −0.0000202				
Comparison population (Hc_1): psychosomatic symptoms				
Distress: equipment (WC_7)	+0.3961	0.0668	0.0000	0.2135
Furniture, environment: good (WC_1)	+0.1755	0.0642	0.0074	0.2768
Computer at home (IC_3)	+0.1626	0.0639	0.0125	0.3119
Leisure: shopping, travel (IC_7)	−0.1454	0.0648	0.0269	0.3422
Leisure: TV and video (IC_{10})	−0.1412	0.0654	0.0330	0.3702
F=12.34 n=105 df=5 p<0.0001 A(constant) = −0.16391				

Table 10 Regression: work interfering in family life

Variables (factors)	B	SE B	Sig T	R^2
Systems analysts (H_4): work interfering in family life				
Family as support (I_{10})	−0.3681	0.0394	0.0000	0.0860
Distress: mental workload (W_4)	+0.1590	0.0401	0.0001	0.1345
Relation with clients: difficult (W_{12})	+0.1415	0.0394	0.0004	0.1611
Satisfaction in life and work (I_4)	−0.1527	0.0387	0.0001	0.1870
Distress: deadlines/work overload (W_3)	+0.1276	0.0405	0.0017	0.2029
Relationship with computer (I_{13})	+0.1248	0.0385	0.0013	0.2164
Work environment/tools: good (W_7)	−0.0974	0.0397	0.0144	0.2269
Solution of work problems outside (I_8)	+0.0852	0.0389	0.0290	0.2338
F = 20.22 n = 538 df = 8 p<0.0001 A (constant) = +0.0002947				
Comparison population (Hc_3): work interfering in family life				
Computer at home (Ic_3)	+0.2764	0.0884	0.0023	0.0859
Short time in the job (Ic_8)	+0.2163	0.0926	0.0213	0.1299
F = 8.06 n = 108 df = 2 p<0.0005 A (constant) = −0.06917				

Visual fatigue was common among systems analysts and was also the most frequent complaint among video display terminal (VDT) users, according to Bergqvist and Knave[13] and Nishiyama.[14]

This study also revealed a positive association between visual complaints and reports of obsolete equipment and bad conditions of furniture. Similar results were reported by Jaschinski and colleagues[15] and Hunting and colleagues.[16]

Characteristics of the task and of work organisation were also associated with visual fatigue among systems analysts and were also found by Villanueva and colleagues[17] and Mocci and colleagues.[18]

Visual fatigue was shown by Rocha and Debert to be more frequent among female systems analysts,[19] and was also observed by Knave and colleagues[20] among computer user workers.

Computer work was associated with the presence of musculoskeletal symptoms in different studies[21–23] and was present in the activity of the systems analysts.

Mental and psychosocial health among systems analysts deserved special attention. According to the World Health Organisation,[24] associations between work and mental health of VDT workers were defined as ''stress related disorders'' and involved physiological, psychological, and behavioural aspects. In the present study, stress related physiological disorders included among systems analysts were symptoms such as palpitation, chest pain, and appetite problems.

The psychological symptoms more frequently seen among systems analysts in the present study were irritability, anxiety, and depression as well as mental and physical fatigue. By interviewing systems analysts, Cohen[1] observed psychological problems such as irritability, depression, tension, and severe fatigue. An investigation by Gredilla and Gonzalez[25] detected anxiety, sleep disorders, and poor mental focus among systems analysts and computer programmers.

In the present study, behavioural changes identified among systems analysts were sleep disorders and the difficulty of turning the mind off work problems. Reviewing sleep disorders, Wisner[26] reported that an intense cognitive effort in the period that precedes night rest induced sleep difficulties.

Work was viewed as interfering with family life in the present study as a result of the extension of work related intense mental absorption to extra-job life. Psychosocial aspects identified as specific by systems analysts were related to the kind of relationship with the computer—an absorbing one in which, by posing constant challenges to the professional, the machine was viewed as inducing a search for perfection, either due to subject identification with the computer or to a need for avoiding the consequences of errors. This kind of behaviour spilled over from work and determined a search for perfectionism at home as well, leading to family conflicts observed in individual interviews.

Some psychosocial aspects related to the contents of the work performed by systems analysts such as impatience and mental acceleration also expressed themselves in personal and family life. Feelings such as impatience and irritation, reported by these workers in a wide range of situations as ''delay in being served'', seem to fit to Rebecchi's[27] observation of a ''psychological dilation of the waiting time and a strong condensation of the working time, the former being a consequence of the latter''. According to the author, this was

Table 11 Regression analysis on work interfering in personal life

Variable (factors)	B	SE B	Sig T	R^2
Systems analysts (H_5): work interfering in personal life				
Relationship with computer (I_{13})	+0.2009	0.0416	0.0000	0.0402
Distress: deadlines/work overload (W_3)	+0.1256	0.0421	0.0030	0.0633
Satisfaction in work and life (I_4)	−0.1153	0.0430	0.0076	0.0762
Workers' participation (W_5)	+0.1230	0.0429	0.0043	0.0892
Distress: equipment (W_9)	+0.0953	0.0417	0.0227	0.0980
Continuing education: adequate (W_{11})	−0.0901	0.0428	0.0358	0.1055
F = 10.45 n = 538 df = 6 p<0.0001 A (constant) = +0.0000555				
Comparison population (Hc_8): work interfering in personal life				
Solution of work problems outside (Wc_{12})	+0.2764	0.0822	0.0011	0.0863
Short time in the job (Ic_8)	+0.2377	0.0863	0.0069	0.1464
F = 9.26 n = 108 df = 2 p<0.0002 A (constant) = −0.02213				

an ''absolutely decisive'' aspect of computerised work, which, by increasing quantitatively the workload, also increased the consumption of psychic energy impressively.

Software program design imposed logical reasoning, formal, binary, detailed thinking and the need to predict the possible results of every single computer operation. This type of reasoning was referred by Rebecchi's discussion on language:[27] ''questions and sequences of operations formulated by the machine have little in common with everyday use of our cognitive abilities. Interactive conversation is reduced to a simple exchange of information suppressing all aspects of informality and redundancy that are necessary in human interaction''.

One of the aspects described by both systems analysts and the comparison population relates to the ''anthropomorphisation'' also discussed by Rebecchi:[27] ''the man is alone in front of the machine, in a position of dependence and, mainly, in a situation in which he sort of 'anthropomorphises' the machine. At first an electronic brain, the computer is turned into a brain and slowly, subtly, almost unconsciously, into a person''.

With regard to the association of work and mental health, the findings of this study showed similarities with Seligmann-Silva's[28] description of mental acceleration which consists in conditioning the mind to work in such a rhythm, and with the same reasoning of the machines, that the operator becomes more and more accelerated, working faster and faster.

In this study, one important aspect of the psychosocial dimension was the difficulty expressed by the systems analysts in dealing with emotions associated with attitudes such as being ''demanding, critical, perfectionist, and methodical'' with themselves and others (family members, colleagues, boss). This kind of interference of work on personal and family life has been described under different denominations, such as ''emotional erosion'' (Frankenhaeuser[29]) and ''alexithimia'' (Karasek and Theorell).[30]

Frankenhaeuser[29] stated, with regard to ''emotional erosion'', that special attention should be given to risks involved in overstimulation, as they may lead to important consequences on the emotional sphere: ''When we are excessively bombarded with strong and frequent stimuli the response of the nervous system gradually weakens; the stimuli lose their impact, and reactions diminish. The physiological effect of stress becomes less intense and the feeling of discomfort decreases. The same happens with the feelings of involvement, empathy and consideration for others. The process is an 'invisible' one, and the gradual wear and tear of the subject's capacity of psychological involvement may be unnoticed.''

Karasek and Theorell[30] described ''alexithimia'' as a difficulty in expressing and distinguishing one's own feelings and the inability to express emotions. These authors also reported the inhibition of emotional expressions as associated with heart disease, especially coronary disease.

All the aspects of mental and psychosocial health among systems analysts were associated with time pressure, constant and intense mental effort, and the specific relationship with the computer. These aspects varied according to the personality, nature of activities, characteristics of work organisation, as well as organisational culture. Smith[31] explored how psychosocial aspects of video display terminal work were related to job stress and their consequences for mental and physical health.

This study points out several aspects on mental and psychosocial health associated with the work of systems analysts that may be extended to professionals responsible for designing web pages or those involved in computer programming.

On the other hand, this study also analysed protective factors that help professionals cope with stress: work satisfaction and leisure activities. Work satisfaction was reported as an important element by system analysts and was associated with fewer symptoms of nervousness and less interference of work in personal and family life. The association between lower frequency of symptoms and higher level of work satisfaction was also observed by Fraser[32] and Elias and Cail.[33]

Despite the complexity of the concept of work satisfaction, it was related among systems analysts, to the meaning of work and to professional acknowledgement, especially in terms of the significance attributed to the final product, which is sometimes referred to as ''a son''.

Leisure activities were reported as being part of the workers' individual strategies to facilitate ''turning the mind off'' work, to reduce mental strain at work and to improve the relationship within the family sphere.

After the discussion of the results at the light of world literature we turn now to the identification of the theoretical framework of the present study. Despite the many different approaches with which stress research has been carried out, we chose the one by Kalimo,[34] who considers stress as a unbalance between the subjects and his environment. According to this concept, stress is not only seen as a result of exogenous factors, but as a dynamic product of a particular combination between, on the one hand, the social and physical environment and the individual, his personality, his behaviour pattern and life history, on the other hand.

This theoretical framework was shown to be broad enough for the evaluation of psychosocial factors involved in the complex reality of systems analysts' work. A new methodological approach included interviews which allowed the disclosure of individuals' subjective dimension and the incorporation to the questionnaire of elements that would otherwise remain unnoticed.

One limitation of the present study was the small size of the comparison population and the fact that it was recruited from only one enterprise. Some of the differences found between the two groups might be organisation specific. Heterogeneity of the comparison population lead to the gathering, through factor analysis, of different dimensions in the same factor. On the other hand, greater homogeneity of the systems analysts' sample allowed the grouping in different factors of specific aspects of each theme.

The cross sectional design was chosen because it is a suitable method for symptom survey.[35] Limitations of the study include its narrow scope (two data processing enterprises), the inclusion of active professionals only, and the difficulties around the time sequence of events in the cross sectional design.

Inferences based on cross sectional studies may be limited. The associations found in the present study between systems analysts' work with visual fatigue, mental health, and the work interfering with personal and family life, must be confirmed in a prospective study.

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