FUNCTIONAL STRESS AND ALTERATION OF THE OCULAR SURFACE IN SUBJECTS VIDEO DISPLAY TERMINAL (VDT)

ELEONORA MARGHERITA CHISARI, CLARA GRAZIA CHISARI*, SANTO DI NUOVO, GIUSEPPE CHISARI**
Department of Education - University of Catania, Italy - *Department Neurosciences , University of Catania, Italy - **Department of Biomedical and Biotechnological Sciences, University of Catania, Italy

ABSTRACT

The authors studied functional stress in subjects video display terminal (VDT) with alterations of the ocular surface. 40 subjects were admitted to the study video display terminal (VDT) (14 males and 26 females, mean age 67+/- 5 yr) with signs and symptoms of discomfort and/or dry eye (burning, foreign body sensation, dryness and itching), with Schirmer I less than 10 mm, with Break-up time Test (B.U.T.) lower at 8 seconds according to the Van Bijsterveld 1 criteria. A test "of perceived stress measurement" (MSP) was performed on all patients to assess the self-perceived stress aspects, "feeling stressed" derived from a widely held tool in the international arena, the Mesuredu Stress Psychologique(MSP). 40 healthy patients, workers, non-VDU operators as controls were also enrolled.

The analysis of individual cluster showed a statistically significant difference between the two groups with regards to only the cluster 1 and 2 (p = 0.03 and p = 0.04, respectively). The correlation analysis showed that there is a positive correlation between the MSP and the number of shifts. Multivariate analysis that place as out as the main the presence or absence of clinically significant stress, found that, controlling for age and sex, the number of shifts and the presence of positive Schirmer test are two risk factors for the development of stress.

An alteration of the ocular surface in (VDT) can easily trigger the chronic process of stress in the terminal operators video subjects with higher exposure to at least 2 hours with changes effectively bacterial microbiota of the ocular surface.

***Keywords**: functional stress, ocular surface, ecosystem eye, display terminal subjects (VDT).*

DOI: 10.19193/0393-6384_2016_5_133

***Received** April 30, 2016; **Accepted** July 02, 2016*

Introduction

Stress is an increasingly frequent of subject studies and research, because of its implications in the workplace. Stress is a condition of the body that allows us to address an obstacle or a problem that must be solved in a short time so that all the psychological resources and / or biological organism are set in motion (neuroendocrine and autonomic mechanisms)[1,2,3,4,5,6,7]. Stress does not always equate to a fatigue condition or conflict, although sometimes it can be the consequence: you are not necessarily stressed because you had a hard day's work, it is whether the work takes on certain characteristics that cause the body specific maladaptive reactions. Stress leads to a state of "pressure" that can evolve in two phases: a defined transitional phase "type temporary stress" (the body is put in a position to react to an event to be approached with the utmost care) and one of "chronic" (stress persists beyond the actual external requirements resulting in an imbalance of operations of the same organism[8,9,10,11,12,13,14].

When this alternation of biological mechanisms stops for any reason, and then the previously activating mechanisms are not disabled, the body remains in constant alert despite there being no need, as is realized the condition of "negative stress". The organism cannot stand still at high rpm and begins to fray resulting in upheaval and profound impairment of biological operations[15,16]. Several studies have highlighted the link between negative stress condition (altered, chronic) with deep biological levels that underlie of many chronic diseases (cardiovascular, dermatology, diabetes, cancer, immune suppression)[17,18,19,20].

And no doubt, that chronic stress, before evolving to determine overt systemic disease, begins with a time of increasing physical and mental illness: headache, pain, fatigue, panic attacks, insomnia, sense of alarm, poor concentration and decision-making, repetitive thoughts, irritability. Although some aspects of stress may be common to anxious subjects, therefore representing closely related phenomena, although the terms "anxiety" and "stress" cannot be used interchangeably. In particular, stress is a condition of the whole organism, while anxiety may represent one of the possible manifestations of stress.

In fact, anxiety involves an emotional involvement exasperated with prevalence of concerns and fears. This approach allows us to understand how anxiety disorders, committed with chronic stress, cannot be differentiated and understood by looking at them from one angle.

Stress is not a disease, but it can "reduce effectiveness at work and may result in a bad state of health". As already highlighted by time, the quality of work and quality of life are intimately linked. Dry eye is a disorder characterized by an alteration of the tear film caused by insufficient production of tears or / and by an altered its[21,22,23] evaporation.

This condition manifests with symptoms of ocular discomfort that may cause damage to the ocular surface and is one of the most common ocular pathologies with a prevalence ranging from 7% to 34% according to epidemiological studies. The surface of the eyepiece system which is part of the tear film is a stable system, but it may lose its balance due to different environmental factors[24,25,26,27,28,29] and chronic diseases. People with dry eye are characterized by a tear film instability with symptoms of burning, foreign body sensation, eyelid fatigue, impaired vision, exacerbated by environmental factors such as air conditioning and exposure to computer monitors. In recent years, some health issues as "office eye syndrome" characterized by the use of VDT (Video Display Terminal) have taken on a particular scientific-health importance. In VDT subjects, one can observe an alteration of the tear film resulting in a possible damage to the ocular surface and characterized by symptoms of ocular discomfort. Recent studies have shown that the increase in certain components of the tear film, these subjects will cause a reduction in its[8,21] stability. In fact, the electronic circuits used to create the image produce static electric and magnetic fields and at low and high frequency electromagnetic fields. The electric and magnetic fields and optical radiation produced by VDT, is virtually the entire electromagnetic spectrum.

The optical radiation emitted includes ultraviolet (UV) light of long wavelength, the visible and the infrared radiation (IR). According to some authors it seems that static electric fields present in the particular conditions of low humidity values, generated by the accumulation of electrical charge caused by electrons striking the screen, are among those that may cause changes to the ocular surface[30,31,32,33]. Based on this knowledge, the purpose of our study was to evaluate the alterations of the ocular surface and the functional stress in subjects VDT[34,35,36,37].

Materials and methods

40 subjects video display terminal (VDT) (14 males and 26 females, mean age 67+/- 5 yr) with signs and symptoms of discomfort and/or dry eye (burning, foreign body sensation, dryness and itching), with Schirmer I less than 10 mm, with Break-up time Test (B.U.T.) lower at 8 seconds according to the Van Bijsterveld 1 criteria. In all patients, the subjective symptoms and objective signs at the time of enrollment visit were taken into account. 40 Healthy patients, workers, no-VDT operators were also enrolled.

Inclusion criteria

- VDT subjects for at least two years, with signs and symptoms of ocular discomfort (burning, foreign body sensation, dryness and itching).
- Subjects with at least three of the four criteria listed above
- No corneal staining with fluorescein
- Absence of ocular surface infections and outbuildings
- Absence of allergic ocular surface diseases
- Exclusion criteria

• Previous eye surgery
• Alteration lacrimal
• Medical therapy with systemic or topical medications that alter the tearing and / or topical steroids during the four weeks preceding the start of the study.

Considered clinical parameters

• Test "of perceived stress measurement"
• Symptoms: foreign body sensation, dryness, itching and burning (objectives Signs: discomfort and / or dry eye)
• Physical examination of the anterior segment performed using slit lamp
• Test of Schirmer I (mm / 5 ')
• Test of Schirmer II (mm / 3 ')
• The tear film break-up time (BUT, sec)
• Conjunctival swab for aerobic and anaerobic bacteria research

Test "of perceived stress measurement" (PSM).

The proposed tests to assess self-perceived stress aspects, "feeling stressed" was derived from a widely held tool in the international arena, the Mesuredu Stress Psychologique (MSP) developed by researchers at the Ecole de Psychologie, University Laval Quebec[12,13]. It is a 49 item questionnaire format based on different aspects related to the perception that the individual has of his state (cognitive - emotional, physiological, behavioral), in a very recent time: the aim is therefore to describe the current state of tension. The content of the stress indexes in this measure come from the normal population (in the sense of not sick), and therefore reflect the variability observed in this population. The scale of the original building criteria, the characteristics of reliability and construct validity both predictive and concurrent, have been described in the book mentioned above[12,13] which are also described in detail the clinical applications and test research in Canada and in other countries including Italy, as well as the procedures followed for the translation, Italian adaptation and standardization of testing and calibration.

Grid for the "PSM" test evaluation (of perceived stress measure)

The overall score calculation:

They must be added to the scores given by the subject for each item.

For the four items and scoring reversed: 22, 24, 43, 49 the evaluation should be done by assigning:

4 points if the subject has indicated 1
3 points if the subject has indicated 2
2 points if the subject has indicated 3
1 point if the subject has indicated 4

In case you miss the score for some items, you should make a correction the score obtained by the formula: (sum of items completed * 49) / Number of Items completed.

Clusters of evaluation:

Clusters I - Loss of control, irritability.

Add up the scores of items: 11, 22, 32, 35, 36, 46 and divide the sum by 6

Clusters II - Feeling psycho physiological

Add up the scores of items: 16, 25, 34, 40 and divide the sum by 4

Clusters III - Sense of effort and confusion

Add up the scores of items: 33, 37, 41, 42 and divide the sum by 4

Clusters IV - Depressive Anxiety

Add up the scores of items: 6, 13, 15, 29 and divide the sum by 4

Clusters V- pains and physical problems

Add up the scores of items: 12, 14, 28 and divide the sum by 3

Clusters VI - hyperactivity, behavior acceleration

Add up the scores of items: 26, 44, 45 and divide the sum by 3

Schirmer I test

A strip of 35 mm long absorbent graduated paper was applied to the outer third of the lower eyelid and the patient was asked to glance up. After 5 minutes, the strips were removed and it the length of wet paper was estimated (normal values between 10 and 15 mm)[3,31,32].

Schirmer II test

We administered one drop of anesthetic (novesina) every three minutes for three times and we proceed as Schirmer I test. After 3 minutes the strips were removed, and portion of paper soaked was estimated (normal >10 mm)[3, 7, 32].

Break-up time Test (B.U.T.)

Small quantity of fluorescein was introduced into the conjunctiva sac and, by the use of a blue filter on a slit lamp biomicroscope, was evaluated the time necessary for the appearance of the first break or dry spot on pre corneal tear film (normal

values range 10-15 sec.) (dryspots)[3, 8, 32].

Bacteriological analysis

Testing of conjunctiva swab Hesswas carried out to search for aerobic and anaerobic bacteria. Samples from patients were seeded in the appropriate culture medium and incubated in aerobic and anaerobic atmosphere for the isolation and identification of bacteria, with separate counts for aerobic and anaerobic bacteria. In particular, each anaerobic bacterial strain, was identified chemically after the specified patterns from "Anaerobe Laboratory Manual", 4th ed., Virginia Polytechnic Institute[1, 10].

Statistical Analysis

The data of clinical parameters (Fig. 1). The data was entered into the basic dates twice and have been checked for completeness and consistency prior to analysis. The quantitative variables were described using mean and standard deviation. Given the normal distribution of data (the Shapiro test for normal data was used) tests were used.

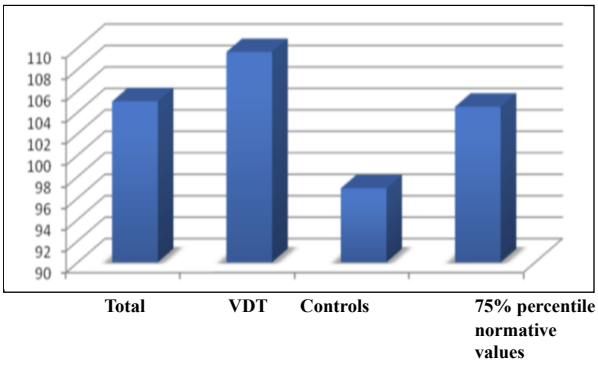

Figure 1: Evaluation of the MPS in subjects VDT operators, controls and regulatory values.
Legend: MPS: Test "of perceived stress measurement", VDT: video terminal operators.

The difference between the average and the difference between proportions was evaluated by t-test and Chi-square, respectively. Correlation analysis was performed between the clinical variables and stress assessment test (Rho, Spearman correlation). It was also performed a multivariate analysis and for each variable inserted in the study was calculated: Odds Ratio (OR), 95% Confidence Interval (CI), p value (two-tailed test, p = 0.05). Multivariate analysis was performed to assess the independent effect of each variable out primary (yes / no stress), controlling for age and sex.

The variables associated with the out as in the multivariate analysis with a p = 0.2 were included consecutively in the final model.

Results

Test "of perceived stress measurement" (PSM).

40 subjects VDT operator subjects with ocular discomfort and 40 subjects not video terminals without any symptoms (controls) were consecutively enrolled. The clinical, demographic and psychological profile inherent stress are described in Table 1.

	Total	VDT (operators)	Controls	P
Number (%)	58	40 (69)	18 (31)	
Males / Females %	38/20 (65.5)	26 (65)	12 (66.6)	0.8
Age (mean±DS)	53.4±5.6	53.5±4.9	53.3±7.2	0.8
MSPscore (mean±DS)	105± 25,0	109.6±24.9	96.9±23.8	0.01
N°.patients with-stress(%)	37 (63.8)	29 (72,5)	9(50)	0.05
cluster 1 (mean±DS)	2.1±0.6	2.4±0.6	1.9±0.5	0.03
cluster 2 (mean±DS)	1.8±0.5	2.1±0.6	1.6±0.4	0.04
cluster 3 (mean±DS)	2.1±0.8	2.0±0.9	1.9±0.7	0.3
cluster 4 (mean±DS)	2.1±0.7	2.0±0.8	1.9±0.6	0.2
cluster 5 (mean±DS)	2.0±0.6	2.1±0.7	1.9±0.5	0.6
cluster 6 (mean±DS)	2.4±0.7	2.5±0.8	2.2±0.6	0.1
N° shift hours of work(mean±DS)	2.7±0.9	2.6±0.9	2.9±0.8	0.3
Years work(mean±DS)	22.4±4.6	22.6±4.7	22.1±4.4	0.7
Test Schirmer I (%)	40 (69)	40 (100)	0	<0.00.1

Table 1: Demographic and clinical characteristics in visual processors subjects and controls.

The two groups do not show statistically significant differences as regards the variables of sex, age, number of work shifts, and years of work. The quantitative analysis of the whole sample showed a score higher than the MSP normative values 75th percentile (Figure 1). Moreover, a more detailed analysis for individual subgroups showed a statistically significant difference between the VDT group and controls for as it regards the MSP score variables and the percentage of patients with clinically significant stress (p = 0.01 and p = 0.05 respectively) (table 1).

The analysis of the individual clusters showed a statistically significant difference between the two groups as regards only the clusters 1 and 2 (p = 0.03 and p = 0.04, respectively) (Table 2 and Figure 2).

The correlation analysis showed that there is a positive correlation between the MSP and the number of shifts (Table 3 and Figure 3).

Val. Cluster	Total	VDT (operators)	No VDT (controls)	Val. thresholds Regulatory 75th percentile
MSP score (mean±DS)	105± 25,0	109.6±24.9	96.9±23.8	104.5
cluster 1 (mean±DS)	2.1±0.6	2.1±0.6	1.9±0.5	2.5
cluster 2 (mean±DS)	1.8±0.5	1.9±0.5	1.6±0.4	2
cluster 3 (mean±DS)	2.1±0.8	2.0±0.9	1.9±0.7	2
cluster 4 (mean±DS)	2.1±0.7	2.0±0.8	1.9±0.6	2.25
cluster 5 (mean±DS)	2±0.6	2.1±0.7	1.9±0.5	2
cluster 6 (mean±DS)	2.4±0.7	2.5±0.8	2.2±0.6	3

Table 2: Assessment of the individual clusters compared with controls and with regulatory values.

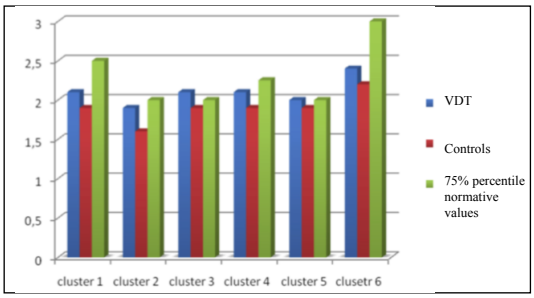

Figure 2: Comparison of individual clusters of video terminal operators subject, controls and normative values. *Legend: VDT: video terminal operators.*

Correlation	*Rho (di Spearman)*	*p*
MPS- sex	-0.3	0.03
MPS-number shifts	0.4	0.01

Table 3: Correlation between the MPS and clinical variables.

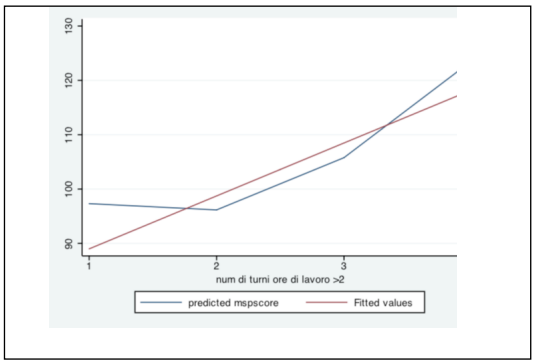

Figure 3: Correlation between MPS and numbers work shifts.

Multivariate analysis which laid out as the main as the presence or absence of clinically significant stress, found that, controlling for age and sex, the number of shifts and the presence of positive Schirmer test are two risk factors for the development of stress (OR 2:08, 1:04 to 4:54 95% CI; OR 2.45 95% CI 1.32-4.67, respectively).

Ocular surface

The figures 4 and 5 highlight the average of tear secretion test values obtained in the two study groups: VDT operators and controls. The data show a difference of tear tests considered in our study, with results following resources respectively VDT and control: Schirmer I 7.8 mm - 11.5 mm; Schirmer II 7.1 mm - 10.6 mm; BUT sec 6.7 - 10.5 sec.

The culture tests have revealed a total of bacterial growth in the group VDT 18 (45%) in comparison examinations 9 (22.5%) observed in the control group (Table 4).

N°. patients (80)	N°. eye (160)		VDT (40)		Control (40)	
	N°	%	N°.	%	N°.	%
Colture tests	27	16.8	18	45.0	9	22.5

Table 4: Total positivity of cultures obtained for an eye between VDT operator subjects versus normal subjects.

The total number of isolations of aerobic and anaerobic bacteria found in two study groups are shown in table 5, where there is a difference of 24 to 16 strains of aerobic and anaerobic isolates from 13 to 7. In some individuals, the simultaneous presence of aerobic and anaerobic bacteria was observed.

Microrganisms	VDT	Control
Aerobic	24	16
Anaerobic	13	7
Total strains	37	23

Table 5: Total number of aerobic and anaerobic isolation from culture tests (VDT operators versus control).

In table 6 are reported the species of aerobic and anaerobic seen in VDT compared to the control.

The clinical parameters of the data (figure n. 4 and 5) The Schirmer I, Schirmer II and B.U.T., obtained in the two groups taken into account are expressed as the mean of the samples. Since the data rather homogeneous, the standard deviation does not deviated much from the average.

E 'was considered appropriate to apply the student T since it deals with classes of samples (paired data) sufficiently homogeneous. Statistical significance of the differences between the "VDT" group and the "control" group was calculated by applying the statistical test "Student" P> 0.001. As regards the amount of bacteria obtained, it was not possible to apply any statistical test.

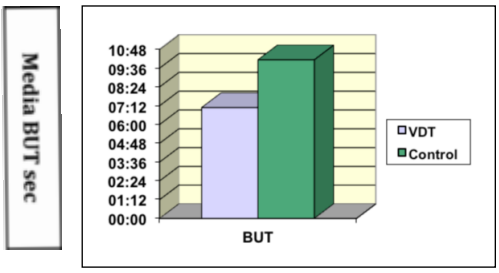

Figure 4: Break-up time between the subjects VDT operators versus normal subjects (control). * P <0.001

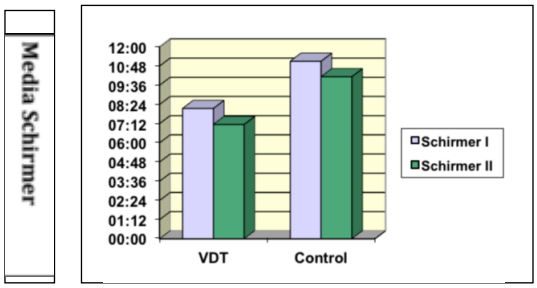

Figure 5: Test of Schirmer I and II obtained between VDT operator subjects compared to controls. * P<0.001

Microrganisms	VDT		Control	
	N°	%	N°	%
S. epidermidis	15	40.5	13	56.6
S. aureus	6	16.3	1	4.3
S.pneumoniae	1	2.7	1	4.3
S.pyogens	1	2.7	1	4.3
H.influenzae	1	2.7	-	
Subtotal aerobic	24		16	
Peptococcus spp.	10	27.0	6	26.2
Peptostreptococcus spp.	3	8.1	1	4.3
Subtotal anaerobic	13		7	
Total strains (aerobic+anaerobic)	37	100	23	100

Table 6: Number and percentage of aerobic and anaerobic bacterial strains isolated from individuals VDT operators than the control.

Conclusions

The significant change in tear testing (Schirmer I, BUT and Schirmer II) obtained in the

VDT operators subject has had a close correlation with the functional analysis of stress. As has been confirmed in previous searches[27,31,33,34,35] a stable tear film is the result of the balance of a series of complex functions implemented by the ocular surface of the system and that its alteration can affect the evolution by a beneficial stress to chronic stress. Admitting the possibility that some biopathological components such as the alteration of the ocular surface may be predisposing factors to a greater evolution to "chronic stress".

In fact, an environment suitable for pH, electrolyte concentration, relative humidity and the presence of the essential nutrient elements is essential because the ocular surface can perform its main functions together with an integration of the normal bacterial flora that exerts a direct action and an indirect defense of the same ocular surface with well-being and comfort of the terminal video worker. The physical barrier function and immunologic by the epithelium of the eye surface is ensured by the tight junction epithelial cell that precisely determines the barrier effect versus pathogenic bacteria. E 'was shown by some studies[1,8,28,36] that if the ismolarity lacrimal increases chronically can determine the damage to the epithelial cells of the ocular surface with consequent instability of sight (visual acuity) of the same subject.

In light of these our first results, we can draw some general considerations, definitely an alteration of the ocular surface in patients VDT operators can easily trigger the process of chronic stress in individuals VDT operators with greater exposure to at least 2 hours. Consequently, the bacteriological of the microbiota changes effectively greatly increases the risk of infection of the eye surface as it is less the biological barrier effect of the tear film.

References

1) Akre BM, DoughtyMJ.Are *There differences "visual symptoms" and specific ocular symptoms Associated with video display terminal (VDT) use?* Cont Lens Anterior Eye. 2007 Jul; 30(3): *174-82*.

2) Aldwin C. *Stress, coping and development, second Edition*. Guilford, New YorkBen-Zur H. 2009.Coping, Styles and affect. International journal of Stress Management, 16, *87-101*.

3) Brewitt H, Sistani F. *Dry eye disease: the scale of the problem*. SurvOphthalmol2001; 45(suppl 2): *199-202*.
4) Courtin R, Pereira B, Naughoton G, Chamoux A, Chiamberetta F, Lannhers C, Dutheil F. *Prevalence of dry eye disease in visual display terminal workers: a systematic review and meta-analysis*. J Pain. 2015; *1526-30*.
5) Chisari G, CG Chisari, L.Rampello, L. Rampello. *Parkinson's disease and ocular surface*. Acta Medica Mediterranea 2011; 27: *73-77*.
6) Chisari G, Greco C, Chisari EM, Chisari CG, Rampello L. *Microbiological characteristics of the ocular surface in the patients with discoid lupus erythematosus*. Acta MedicaMediterranea 2015; 31: *1057-62*.
7) Chisari CG, Greco C, Chisari EM, Rampello L, Chisari G *The ocularsurface in the Discoid Lupus Erythematosus*. ActaMedicaMediterranea 2015; 31: *1217-21*.
8) Chisari G, Stagni E, Rampello L, Malaguarnera M, ChisariCG. *The ocular surface in patients video display terminal (VDT)*. Acta Medica Mediterranea 2013; III: *369-73*.
9) Chisari CG, Stagni E, Di Mauro M, DiMauro M, Giordano M, Fichera SS, Motta M, Chisari EM, Chisari G. *Risk factors for ocular surface disorders in patients with type 2 diabetes*. Acta Medica Mediterranea 2014; 30: *249-53*.
10) Chisari G, *Endophthalmitis: Gram positiveethiological agents and susceptibility to glycopeptides*. Curr Clin Pharmacol. 2008 Sep; 3(3): *153-5*.
11) Chisari G, Chisari CG, Reibaldi M, Patti F. *Ruolo terapeutico della carbossimetilcellulosa allo 0.5% sulla superficie oculare del soggetto con sclerosi multipla possibile*. Ottica Fisiopat 2009; XIIV: *197-202*.
12) Di Nuovo S. *La vacanza da piacere a fonte di stress: una nuova frontiera per la psicologia del turismo. In psicologia del turismo: prospettive future(a cura di A*. Albanese e C. Cristini), 2007; Franco Angeli, Milano, *89-99*.
13) Di Nuovo S., Lo verso G. Come funzionano le psicoterapie. La ricercaitaliana. FrancoAngeli, 2005; Milano.
14) Di Nuovo S., Zanchi S. *Scelte professionali e benessere lavorativo: una ricerca empirica*. Risorsa Uomo, 2008; XIV, 3, *263-277*.
15) Ferreira CM, Vieira AT, Vinolo MA, Oliveira FA, Curi R, Martins Fdos S. *The central role of the gut microbiota in chronic inflammatory diseases*. J Immunol Res. (2014): *689-92*.
16) FizPerez FJ, Laudadio A. *Colpire lo stress: il coping. Teorie, ricerche, strumenti*. FrancoAngeli, 2011; Milano.
17) Galor A, Covington D, Levitt AE, McManus KT, Seiden B, Felix ER, Kalangara J, Feuer W, Patin DJ, Martin ER, Sarantopoulos KD, Levitt RC. *Neuropathic Ocular Pain due to Dry Eye Is Associated With Multiple Comorbid Chronic Pain Syndromes*. Mini Rev Med Chem. 2015; 16(3): *241-57*.
18) Goldsmith JR, Sartor RB. *The role of diet on intestinal microbiota metabolism: downstream impacts on host immune function and health, and therapeutic implications*. J Gastroenterol. 2014; 49(5): *785-98*.
19) González-Méijome JM, Parafita MA, Yebra-Pimentel E, Almeida. *Symptoms in a population of contact lens and noncontact lens wearers under different environmental conditions*.Optom Vis Sci. 2007 Apr; 84(4): *296-302*.
20) Guo, B., Lu, P., Chen, X., Zhang, W., Chen, R. *Prevalence of dry eye disease in Momgolians at high altitude in China: The henan eye study* .Ophthalmic Epidemiology, 2010; 17 (4), pp. *234-241*.
21) Kaido M, Ishida R, Dogru M, Tsubota K. *Visual function changes after punctal occlusion with the treatment of short BUT type of dry eye*. Cornea. 2012; 31: *1009-13*.
22) Karg K, Burmeister M, Shedden K, Sen S. *The serotonin trasporter promoter variant (5-HTTLPR), stress and depression Meta-alalysisRevisited.Evidence of Genetic Moderation*. Archives of General Psychiatry, 2011; 68, 5, *444-454*.
23) Lipoma M, Di Corrado D, Di Nuovo S,Perciavalle V. (2005). *Stress, adattamento interpersonale e prestazione sportiva*. Italian Journal of Sport Sciences, 12, *125-128*.
24) Miljanović, B., Dana, R., Sullivan, D.A., Schaumberg, D.A *Inpact of Dry Eye Syndrome on Vision-Related Quality of Life* (2007) American Journal of Ophthalmology, 143 (3); *409-415*.
25) Miller KL, Walt JG, Mink DR, Satram-Hoang S, Wilson SE, Perry HD, Asbell PA, Pflugfelder SC. *Minimal clinically important difference for the ocular surface disease index*. Arch Ophthalmol. 2010; 128(1): *94-101*.
26) Moss SE, Klein R, Klein BE. *Prevalence of and risk factors for dry eye syndrome* Arch Ophthalmol. 2000 Sep; 118(9): *1264-8*.
27) Murube J, Murube E. *Near vision accommodation in horizontality with VDT: why low blinking and dry eye?* Adv Exp Med Biol. 2002;506(Pt B): *1205-11*.
28) Nichols KK. *Patient-reported symptoms in dry dye disease*. Ocul Surf 4: *137-145*, 2006.
29) Pflugfelder SC, Solomon A, Stern ME. The diagnosis and management of dry eye: a twenty-five-year review. Cornea 2000; 19: *644-649*.
30) Schlote T, Kadner G, Freudenthaler N. *Marked reduction and distinct patterns of eye blinking in patients with moderately dry eyes during video display terminal use*. Graefes Arch Clin Exp Ophthalmol. 2004 Apr; 242(4): *306-12*.
31) Smith PM, Howitt MR, Panikov N, Michaud M, Gallini CA, Bohlooly-Y M, Glickman JN, Garrett WS. *The microbial metabolites, short-chain fatty acids, regulate colonic Treg cell homeostasis*. Science. 2013 Aug 2: *569-73*.
32) Smith, J.A., Albenz, J., Begley, C., Caffery, B., Nichols, K., Schaumberg, D., Schein, O. *The epidemiology of dry eye disease: Report of the epidemiology subcommittee of the international Dry Eye Word Shop* (2007) Ocular Surface, 5 (2), *93-107*.
33) Wopereis H, Oozeer R, Knipping K, Belzer C, Knol J. *The first thousand days - intestinal microbiology of early life: establishing a symbiosis*. Pediatr Allergy Immunol. 2014: *428-38*.
34) Kruk J, Kubasik-Kladna K, Aboul-EneinHY. *The Role Oxidative Stress in the Pathogenesis of Eye Diseases: Current Status and a Dual Role of Physical Activity*. Pak J Med Sci. 2015; 31(3): *626-31*.
35) Yilmaz U, Gokler ME, Unsal A *Dry eye disease and*

depression-anxiety-stress: A hospital-based case control study in Turkey. P J Medical Sciences Volume 31, Issue 3, 2015: *626-63*.

36) Uchino M, Schaumberg DA, Dogru M, Uchino Y, Fukagawa K, Shimmura S, Satoh T, Takebayashi T, Tsubota K. *Prevalence of dry eye disease among Japanese visual display terminal users*. Ophthalmology. 2008 Nov; 115(11): *1982-8*.

37) Vrieze A, Holleman F, Zoetendal EG, de Vos WM, Hoekstra JB, Nieuwdorp M. *The environment within: how gut microbiota may influence metabolism and body composition*. Diabetologia. 2010; 53(4): *606-13*.

Corresponding author
Prof. GIUSEPPE CHISARI
Department of Biomedical and Biotechnological Sciences
Sez.: Microbiology
University of Catania
(Italy)