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THE EFFECT OF DAILY STRESSORS ON VEGETATIVE REGULATION: THE AGE ASPECT

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Abstract

The presented study investigated the interrelationship between vegetative regulation and factors of daily stressors in adults. The objective was to determine paths of influence exerted by daily stressors on vegetative regulation in different periods of adulthood. Three hundred forty eight people aged 20-68 years (males – 126, females – 226) participated in the study. In order to calculate vegetative regulation index we used blood pressure levels; readings of the «AngioScan» device designed for assessment of the cardiovascular system condition and electrocardiography (ECG) parameters. Daily stressors were studied using a questionnaire "Daily Stressors" which revealed 10 types of daily stressors. We investigated factors of daily stressors, peculiarities of the vegetative status and stress index in the age groups of early, middle and late adulthood. The paper describes specifics of their manifestation in the age aspect. We revealed prevailing of the dominating type of vegetative index "sympathetic and parasympathetic effects balance" in a sample; parasympathetic effect in the groups of early and middle adulthood and intensified sympathetic effect in late adulthood. When analyzing the path model we found the direct effect of daily stressors on vegetative regulation and the reverse effect of the age in late adulthood. The study showed a cumulative effect of daily stressors in manifestation of ergotropy. Goodness measure values of the models confirmed their empiric correctness.

Keywords: Daily stressors, vegetative regulation, clinostatic test, adul**t**.

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1. Introduction

The life of the modern human is inseparably linked with periodical exposure to unfavorable factors which include daily stressors. Daily troubles (stressors) surround him from every quarter: family problems, minor nuisances associated with labor relations, feeling of loneliness, concern about relatives, financial difficulties, traffic congestions etc. The nature of such interaction is different. On the one hand, a person immersed in active life rhythm does not notice such effects and gets accustomed so that ceases to feel their intensity. On the other hand, absolutely insignificant events sometimes become critical for the human and cause a flow of negative emotions and experiences. The researchers working in the field of investigation of stress state that the accumulative effect of daily stressors may be more significant than consequences of serious life situations (Kuper, Dejv, & O'Drajskoll, 2007; O'Connor, Jones, Conner, McMillan, & Ferguson, 2008; Holahan & Holahan, 1987; DeLongis, Coyne, Dakof, Folkman, & Lazarus, 1987). They are able to cause disturbance of the somatic health (Harlamenkova, 2016); result in the higher psycho-emotional strain, promote the development of diseases (Sapolsky, 2002; Ganster & Rosen, 2013) have a negative impact on satisfaction with marriage (Totenhagen et al., 2012); mnemic processes (Stawski, Almeida, Lachman, & Tun, 2010). The negative effect exerted by stressors associated with the labor process (e.g., shift work), is manifested in social and family relations and also in disturbed sleep and rest rhythm (Centofanti, 2015; Van der Ploeg & Kleber, 2003; Frank & Ovens, 2002; Ward, Lombard, & Gwebushe, 2006). In spite of the interest to above problem, the influence exerted by daily stressors on the human psychophysiological state remains insufficiently studied. We decided to contribute to this field and consider features of the effect exerted by daily stressors on the physiologic peculiarities of adults.

2. Problem Statement

The investigation of physiologic peculiarities of the human organism associated with recovery process when experiencing daily stressors is an urgent scientific and practical task. There exists a close interrelationship between the psychic and somatic health. Physiologists found that the stress reaction was formed by the interrelations of the working organism and psychic activity, i.e. all organism systems: cardiovascular, endocrine, gastrointestinal and other systems were involved in the reaction to stress. Close co-existence of the sympathetic and parasympathetic parts of the vegetative nervous system and humoral factors provides for adaptation to changing conditions of the internal medium and the environment.

The studies performed within the limits of medical and preventive measures are evidence of the more frequent effects of stress events on the cardiovascular system activity (Thayer, Ahs, Fredrikson, Sollers, & Wager 2012; Lennartsson, Jonsdottirac, & Sjörsad, 2016). Therefore, physiologic values of the heart rate and pulse rate depend on many factors such as gender, age, presence of physical and emotional stresses, time of the day, body temperature, food intake and many others. The nature of reaction of the cardiovascular system to a stress situation is of great importance in assessment of the organism functional condition (Gouin, Deschênes, & Dugas, 2014). Different functional tests are used in order to assess the functional condition of the heart and vegetative mechanisms for cardiac rhythm regulation. The purpose of these tests is to elucidate the reaction of the vegetative nervous system to external stimuli.

Studying daily stressors in combination with vegetative regulation in adults will allow to extend the knowledge about the effect of daily stressors on the functional organism condition regarding vegetative regulation.

3. Research Questions

We made the following assumptions as a hypothesis of the study:

- The intensity of daily stressors and stress index influence vegetative regulation so that they favor higher sympathetic effects and result in physiologic exhaustion.
- Vegetative regulation is determined by the age and correlated negatively with the clinostatic test.
- The pattern of relationship structure between daily stressors, stress index and vegetative regulation will be different in different age periods

4. Purpose of the Study

The purpose of this study was to investigate the paths of influence exerted by daily stressors on vegetative regulation in different adulthood periods; reveal types of vegetative regulation in a sample; study the interrelationship between vegetative index and daily stressors, results of clinostatic test and age; elucidate the role of the age and daily stressors in vegetative regulation.

5. Research Methods

Participants. The study involved 348 people including 126 males (M_{age}=35.1; SD=10.5) and 226 females (M_{age}=38.6; SD=11.4). At the time of the study, all participants were employed people engaged in different professional spheres. The sample was divided in three age groups: early adulthood, age from 20 to 29 years (M_{age}=25.8; SD=2.48); middle adulthood, age from 30 to 44 years (M_{age}=35.7; SD=4.41) and late adulthood, age from 45 to 68 years (M_{age}=52.9; SD=6.02).

Procedures. The study was performed on the voluntary basis and consisted of two blocks: physiologic assessment of the organism condition conducted by a physician-cardiologist and fulfilment of psychodiagnostic procedures intended for investigation of daily stress.

5.1. Measures

Measures. Daily stress. In order to study daily stressors, we used a "Questionnaire of daily stressors" (Petrash, Strizhickaya, Savenysheva, & Golovej, 2018) developed in accordance with the study objectives. Primary validation revealed high values of Cronbach's coefficient alpha which was 0.949. The questionnaire included 10 factors of daily stress: "Work – Affairs", "Relations with surrounding people", "Failure to fulfill plans", "Finances", "Planning", "Family problems", "Surrounding reality", "Well-being – Loneliness", "General well-being", "Competition". We calculated the intensity of each factor separately and total daily stress index. Due to heterogeneous filling of factors by the number of items included in them (from 5 to 10), we calculated the intensity of each factor in percentage in order to perform the comparative analysis and compare stress burden in different life spheres.

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Vegetative regulation. We used the data obtained with the help of devices AngioScan-01P, KFS-01.001 "Cardiometer-MT" electrocardiograph and Little Doctor LD-81 atrial pressure measuring device in order to calculate coefficients of vegetative regulation. AngioScan-01P. The device is clip-shaped (AngioScan, n.d.; Parfenov, 2013). The index finger should be placed inside the device in order to perform the test. The results measured by the device allow to determine the following parameters: "Pulse rate" – makes it possible to assess the training status of the cardiovascular system: the higher the pulse rate at rest is, the less trained the cardiovascular system is. People performing regular physical exercises have the pulse rate at rest in the range of 55-60 what may be assessed as excellent condition, pulse rate at rest of 60-80 may be estimated and good condition and pulse rate of more than 80 as poor condition. The pulse rate of more than 80 may indicate the sedentary life style; parameter *«age of the cardiovascular system»* assesses the small vessels system. The parameter values are considered favorable then the «age of vessels» is less than the chronologic age; *«vessel rigidity»* characterizes the condition of major arteries. A negative parameter value is evidence of elasticity of the aorta and major arteries. The range from -20% to -30% is the optimum value for this parameter; *«stress index»* has the quantitative characteristics: 50-150 is considered as the normal condition of mechanisms regulating the cardiovascular system; 150-500 means stress, physical activities, fatigue; 500-900 is assessed as psychophysiological fatigue, significant stress; 900-1500 means significant disturbance of regulatory mechanisms.

Electrocardiographic investigation allows to assess the heart function. These observation results were of extreme importance in order to study specifics in experiencing daily stressors in the life of an average statistical human. The parameters which were considered in the data analysis included: heart rate, cardiac rhythm, electric axis of the heart and revealed changes in cardiac excitability, conduction and contractility within the limits of their influence of the pulse wave parameters.

Little Doctor LD-81 mechanical tonometer for measuring the blood pressure. Blood pressure (BP) is the pressure applied by the blood to arterial walls. Values of systolic and diastolic blood pressure were used by us in order to assess the vegetative status (Kerdo index).

Vegetative index (Kerdo index). Kerdo index is calculated using the formula: I_{Kerdo}=(1-BPd/Puls)*100, where: I_{Kerdo} is vegetative index, BPd is diastolic pressure (Melnikova, 2009). Five tonus types are distinguished according to vegetative nervous system (VNS) condition: pronounced parasympathicotonia, i.e. parasympathetic tonus predomination, parameter values of more than (-31); parasympathicotonia, i.e. intermediate condition between the norm and parasympathetic tonus, values from -16 to -30); norm, i.e. equilibrium between the sympathetic and parasympathetic influences, values from -15 to + 15); sympathicotonia, i.e. an intermediate condition between the norm and sympathetic tonus, values from +16 to +30; pronounced sympathicotonia, predomination of sympathetic tonus, values of more than (+31).

A positive value is evidence of predomination of sympathetic influences, and a negative value reflects predomination of parasympathetic influences. Sympathiconia is characterized by predomination of dissimilation processes, extraversion, greater activity, i.e. *ergotropy.* Parasympaticotonia is characterized by assimilation processes, lowered activity, introversion, i.e. *trophotropy.*

Clinostatic test. This is a method for investigation of the cardiovascular system condition which allows to determine functioning of the parasympathetic part of the vegetative nervous system. A difference is calculated between the pulse rate in upright/sitting position and in the horizontal position

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what should lead to excitation of the parasympathetic nervous system. The normal difference varies from 5 to 10 beats per minute; increase of this value from 11 and above evidences the higher excitability of the parasympathetic part of the vegetative nervous system. If the difference is from 4 points and lower one may speak of lowered recovery processes.

Statistical analyses. All hypotheses were considered using a path model (path model analysis) allowing to assess the cause-effect relationships between explicit variables. We used SPSS 20 and AMOS20 software package. The models were considered separately for each age group.

6. Findings

6.1. Daily stressors

The data on the intensity of daily stressor parameters in the age groups, means and standard deviations is presented in Table 1. We used single-factor analysis of variance ANOVA for comparative analysis of age-related differences. The results did not reveal any significant differences by stressor intensity between the distinguished groups. The factor «Problems in family relations» was the exclusion; its maximum intensity was observed in the groups of middle and late adulthood as compared to respondents of the first group ($p \leq 0.05$). The revealed trend may be associated with age and explained by the maximum number of not married people in the first group (20-29 years). The considerable dispersion of the factor intensity in the age groups indicates the individual character regarding experiencing the daily troubles.

The analysis of intensity of experiencing the stressor factors (Table 1) showed that events associated with the work and general well-being took the first two places in the structure of daily stressors in representatives of the first and second groups. The family takes the first place in the third group. Appearance of the factor "competition" on the third position in young participants of the study may be noted as a characteristic feature. At the same time the family factor is shifted to the seventh position. Correlation analysis revealed weak interrelationship between the age and one factor of daily stressors «family problems» ($r=.114$, $p=.033$). One may suppose that specifics of experiencing stressors and their intensity depend on other characteristics, e.g. human physiologic features. This is the basis of our study.

Table 01. Descriptive statistic of Study Variables on the Daily Stressors in the age groups

Factors of Daily Stressors	20-29 (n=105)		30-44 (n=150)		45-68 (n=93)		F
	M (SD)		M (SD)		M (SD)		
Work - business	30.92	30.92 (20.3)	30.07	30.07 (22.4)	26.81	26.81 (22.7)	0.98
Relations with others	15.21	13.69 (15.5)	12.76	11.48 (15.1)	14.86	13.38 (17.0)	0.74
Plans interruption	16.15	8.08 (8.6)	15.19	7.59 (9.46)	12.47	6.24 (9.06)	1.08
Finance	22.32	13.39 (11.9)	24.58	14.75 (14.6)	24.01	14.41 (14.6)	0.30
Planning	16.29	9.77 (10.6)	19.44	11.67 (11.8)	14.07	8.44 (9.74)	2.64
Family problems	20.38	12.23 (11.9)	25.81	15.49 (13.2)	28.23	16.94 (14.4)	3.42*
Environment	13.37	6.69 (8.31)	11.05	5.53 (7.72)	15.89	7.95 (9.59)	2.39
Feelings – loneliness	22.25	11.12 (10.1)	21.08	10.54 (9.91)	21.25	10.62 (10.5)	0.11
State of health	27.10	13.55 (10.3)	26.64	13.32 (10.1)	26.86	13.43 (10.2)	0.02
Competition	23.56	11.78 (10.1)	22.12	11.06 (10.3)	22.99	11.49 (11.2)	0.15
Total	20.87	114.8 (80.3)	20.78	114.3 (85.8)	20.61	113.4 (89.8)	0.01

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6.2. Physiologic characteristics

As concern physiologic parameters, we considered peculiarities of the cardiovascular system functioning in this part of the study. Table 2 presents the data on comparative analysis by the test parameters in the age groups.

We showed differences in the vascular age (p≤0.001). The differences were predictable because the minimum biological age was revealed in the early adulthood group. But some peculiarities should be noted. The comparative analysis of the age and vascular age parameters using t-test for one sample showed that the biological age in the first group exceeded the chronologic age (t=11.56, p=.000). The negative relationship was revealed in the study participants from the middle and older age groups, i.e. their biological age was less than the chronological age (t=-3.89, p=.000 and t=-9.53, p=.000, respectively). The lowest values of stress index were revealed in the representatives of the first group as compared to two older ages (p≤0.001). The analysis of systolic and diastolic blood pressure levels revealed significantly increased parameter values in the older age group (p≤0.001) what was also predictable and associated with age-related peculiarities.

Table 02. Means and standard deviations of study vegetative characteristics in the age groups

Physiologic characteristics	20-29 (n=105)		30-44 (n=150)		45-68 (n=93)		F
	M (SD)		M (SD)		M (SD)		
Pulse rate (AngioScan)	73.58	9.98	74.82	10.53	72.10	11.28	1.92
Biological age of the vascular system	30.90	5.23	33.37	7.32	43.15	9.86	72.52***
Stiffness of arterial wall	-1.27	25.55	-4.69	10.71	5.22	12.43	.98
Stress index	62.74	49.42	93.78	91.53	149.66	165.50	16.33***
Systolic pressure	116.64	20.57	120.53	14.60	135.48	20.70	29.38***
Diastolic pressure	75.95	8.83	77.30	8.31	85.09	9.88	30.59***
Pulse rate (ECG)	65.80	10.91	67.31	10.44	65.72	10.78	.902
Clinoostatic test	7.78	7.36	7.51	6.69	6.38	7.04	1.13
Vegetative index (Ind.Kerdö)	-18.27	22.59	-17.11	19.54	-32.64	25.41	15.81***

Note. *p<0.05; ** p<0.01; *** p<0.001.

6.1. Vegetative index

The study revealed significant difference in the vegetative index parameter in representatives of the older age group (p≤0.001). Isolated cases of sympathicotonia should be noted as a general trend. The data is presented in Table 3. The normal type predominated in the first and second groups what was evidence of the balance between sympathetic and parasympathetic effects (45.7% and 50.0%, respectively). The percentage of parasympathicotonia and pronounced sympathicotonia was identical in these groups. The older age group was characterized by predomination of the type "pronounced parasympathicotonia" (55.9%).

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Table 03. Descriptive statistic of Study Variables on the Index Kerdö

Vegetative types	Age groups (in years)		
	20-29	30-44	45-68
	n (%)	n (%)	n (%)
Expressed parasympathicotonia	22 (21.0)	39 (26.0)	52 (55.9)
Parasympathicotonia	28 (26.7)	33 (22.0)	20 (21.5)
Balance of sympathetic and parasympathetic effects	48 (45.7)	75 (50.0)	19 (20.4)
Sympathicotonia	7 (6.6)	3 (2.0)	2 (2.2)

Only 19 representatives from the third group had the normal type (20.4 %). On the one hand, the groups were characterized by considerable dispersion by some parameters, and on the other hand, a special position of the older age group was observed.

6.2. Path modelling

A path model 1 presented in Fig. 1, reflects peculiarities in the interrelationship between the parameter of daily stress and physiological peculiarities in the first age group (20-29 years). The study showed the influence exerted by the stressor "Well-being – Loneliness" on the vegetative status through increased intensity of stress index. Personal emotions and feelings associated with general well-being lead to increased stress index what promotes appearance of ergotropy and results in energy potential exhaustion. The negative interrelationship between the parameters of clinostatic test and vegetative status reflects a favorable prognostic path. It evidences the intensity of the parasympathetic effect which is associated with the recovery potential of the organism, i.e. trophotropy. The values of model goodness measures are within acceptable limits taking into account the sample size, i.e. the model is confirmed empirically ($\chi 2$=1.989; df=3; $\chi 2$/df=.663; p=.575; CFI=1.000; GFI=.991; RMSEA=.000; PCLOSE=.670).

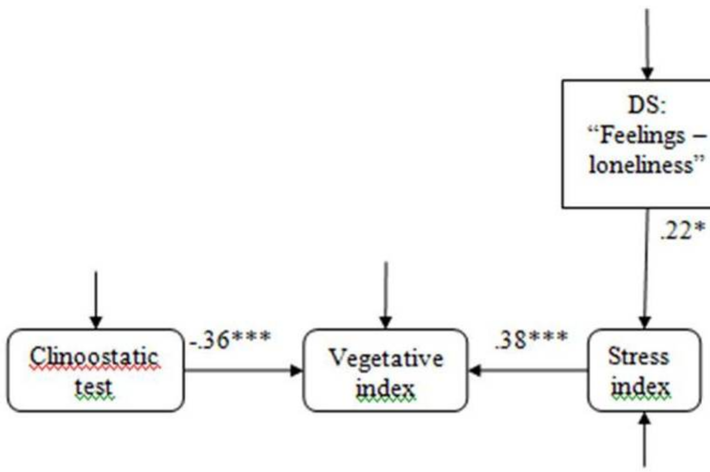

Figure 01. Path model 1

The path model 2 for the age group of middle adulthood period presented in Fig. 2, has somewhat another structure. The total parameter value of daily stressors has a direct effect on the value of vegetative index what is evidence of intensified sympathetic effects. The model structure includes the age characteristic which has an effect of the increase of vegetative status through intensified stress index. The next peculiarity consists in the fact that older representatives from this age group are subject to ergotropy

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to a greater extent. Intensification of the sympathetic effect occurs due to increased stress index. The values of the model criteria are within the range of their compliance what is evidence of a good model ($\chi2$=1.647; df=3; $\chi2$/df=.549; p=.649; CFI=1.000; GFI=.995; RMSEA=.000; PCLOSE=.764).

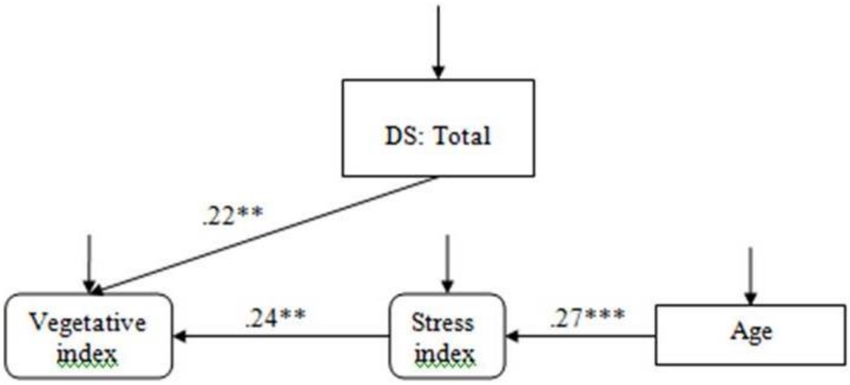

Figure 02. Path model 2

Prognostication of the negative influence exerted by daily stressors on the vegetative status in the older age group is presented in the path model 3 in Fig. 3. The structure of significant paths in this group has its characteristic features. The study showed the direct influence exerted by the stressor «Interpersonal interaction» and the parameter «Stress index» on the vegetative status, revealed negative interrelationships with parameters of the clinostatic test and age. The age factor showed itself in this group differently as compared to the middle group. The study revealed a negative contribution of the age factor to vegetative index and the parameter «clinostatic test». The revealed model paths enable us to speak of possible intensification of the sympathetic effect in the younger participants of this age category and parasympathetic in the older ones. The values of model criteria indicate its empirical correctness ($\chi2$=2.781; df=5; $\chi2$/df=.556; p=.734; CFI=1.000; GFI=.988; RMSEA=.000; PCLOSE=.817).

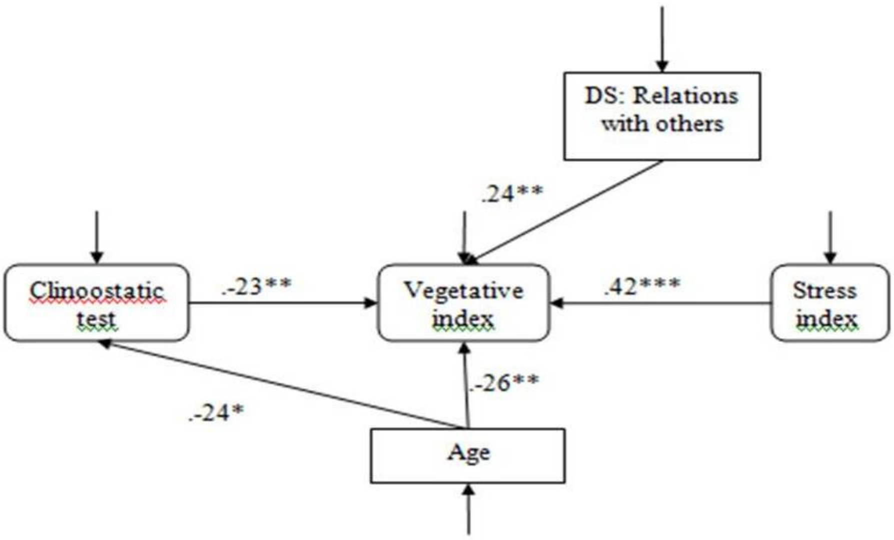

Figure 03. Path model 3

7. Conclusion

The study did not reveal any considerable differences in the intensity of daily stressors between the age groups except for the parameter «family problems»: the greater intensity was observed in the representatives of older ages. We found predomination of the normal type of vegetative regulation in representatives of the early and middle adulthood groups. It was shown that representatives from the later adulthood group were characterized by predomination of the type «pronounced parasympathicotonia».

The study revealed a negative correlation between vegetative coefficient and the age, positive correlation with the general parameter of daily stressors and negative correlation with the clinostatic test.

The following peculiarities were found in the age groups using the model analysis:

The effect of the stressor «Well-being - Loneliness» on the vegetative status through intensification of stress index favoring manifestation of ergotropy was detected in the early adulthood. The *middle adulthood* period was characterized by revealed cumulative effect of daily stressors in manifestation of ergotropy and the influence of the age factor on increase of the vegetative status through intensification of stress index. The study revealed the direct effect of the daily stressor «Interpersonal interaction» and parameter «Stress index», negative effect of the factor «Age» on the vegetative status favoring manifestation of ergotropy in the *late adulthood*. We found the negative interrelationships with the parameters of the clinostatic test and age.

The analysis of path models in the age groups elucidates the mechanisms of interaction between daily stressors and vegetative regulation promoting energy potential exhaustion depending on the age aspect. The obtained results emphasize the role of daily stressors in manifestation of ergotropy and set the problem of need to perform further studies in this field for researchers.

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