

## DAILY DYNAMIC OF INDICATORS OF GIRL-STUDENTS' BLOOD MICRO-CIRCULATION

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**Abstract.** *Purpose:* study daily dynamic of indicators of girl-students' blood micro-circulation. *Material:* 340 girls of 17-19 years old age were examined. The method of laser Doppler's flow metering was used. *Results:* The state of tissue blood circulation was determined. Character of micro-circulation's changes under influence of daily bio-rhythms was detected. In first half of day tension of mechanisms of micro-circulation's regulation takes place. Partially it reduces by 4 p.m. at the account of strengthening of metabolic components of vasomotor rhythm. In evening period there is observed compensatory increasing of breathing and pulse modulations. It is connected with weakening of sympathetic and strengthening of parasympathetic impacts on tissue blood circulation. Also we registered changes in correlation of rhythmic components of tissue blood circulation's oscillations at the accounts of weakening of vasomotor rhythm. It witnesses about tension of regulatory mechanisms. *Conclusions:* it is recommended to use the received data as normative indicators of laser Doppler's flow metering when studying pathological processes.

**Key words:** blood micro-circulation, daily dynamic, laser Doppler's flow metering, bio-rhythms, girl students.

### Introduction

One of important modern problems is health of population. Environment and heredity influence on all structures of human organism [11]. Complex examination of girl students' health, as far as they are a social group with increased risk of organism's functional disorders, is especially important. Their age is the most optimal for realization of reproductive function [13, 15, 16].

In diagnostic of different diseases one of leading places is engaged by problem of study of blood micro-circulation. In this case micro-circular link is regarded as sub-system of all vessels' system, in which main function is realized: ensuring of trans-capillary exchange and its response to environmental and internal factors [6]. It is evident that changes in blood microcirculation's system are in close correlation with shifts in central haemo-dynamic. It permits to use parameters of micro-circulation as criteria in assessment of examined persons' health [11, 17, 19].

At present one of main methods of micro-circulation studying is laser Doppler's flow metering (LDF). LDF is method of integral non-invasive assessment of micro-circulation haemo-dynamic in tissues. LDF is also a proved method of diagnostic of micro-circulation disorders [1, 2, 8, 9, 10, 18]. That is why demand in working out and substantiation of new methodic techniques, based on LDF, is evident. However, at present reliable criteria for application of laser Doppler's flow metering of healthy persons are absent.

Thus, detection of interconnection between blood micro-circulation indicators and daily dynamic of girl-students is rather urgent.

### Purpose, tasks of the work, material and methods

*The purpose of the work:* to study daily dynamic of micro-circulation of girl-students.

The tested contingent consisted of 340 girl-students of Melitopol State Pedagogical university, who related to junior age group (from 17 to 19 years old). In ethnic aspect most of the tested girls were Ukrainian and Russian, who lived in South-East of Ukraine.

*The methods and organization of the research:*

In order to study functional state and specific features of micro-circulation in women's organism we used method of laser Doppler's flow metering (LDF). This method permits to added tissue blood circulation and detect the signs of micro-circulation changes under influence of daily bio-rhythms.

LDF was conducted with the help of Laser analyzer of blood flow "LAKK-01" «ЛІАКК-01» (production of НПП «Лазма», SIA "Lasma", Russia) with laser source of light at wave length of 0.63 mcm. Laser analyzer was connected with computer. The curve of LDF recording is depicted on monitor in real time. The girls were tested in sitting position. The head of optical probe (sensor of the instrument) was fixed in ventral surface of 4<sup>th</sup> finger of left hand; the hand was located wt level of heart, Standard recording lasted 3 minutes [7, 14].

Computer program for processing of LDF records permits to determine the following characteristics of micro-circulation: PM – parameter of micro-circulation; MSD – mean square deviation of registered Doppler signals from mean value; Cv – coefficient of variation, measured in %. Results of LDF testing were registered in relative perfusion units (*perfusion units – perf. un.*), which reflect: degree of perfusion by mainly erythrocyte fraction; units of tissue volume per unit of time. Important stage of LDF metering is analysis of amplitude-frequency variety of blood flow components – (*AFV*) of tissue blood flow oscillations' haemo-dynamic rhythms: VLF – metabolic oscillations, LF – vasomotor oscillations, HF –breath oscillations, CF –pulse waves.

For every tested indicator of micro-circulation we calculated mean arithmetic  $M$ , error of mean value  $m$ , mean square deviation  $\delta$ . Evaluation of confidence was carried out with the help of Sjudent's t-criterion for sample with

unequal quantity of observations. Statistical processing of results was fulfilled in Microsoft Excel. The received data were processed with the help of basic package of programs for statistical processing of data.

**Results of the research**

It is known that during day human workability changes as well as degree of tension of different regulatory mechanisms in human vegetative sphere [3, 4, 12]. In this connection we made LDF records of girls with standard type of daily micro-circulation. For this purpose we made record at 8:00 a.m., 12:00 a.m., 4 p.m., 7 p.m. and 11 p.m. In fig. 1-5 daily monitoring of LDF record of one girl is depicted.

Minimal value of micro-circulation parameter (PM) was registered at 12 a.m. – 16.9±0.5 perfusion units (perf. un.). Mean square deviation (MSD) of girls was the following: at 8 a.m. – 1.34±0.07 perf. un.; at 12 a.m. it reduced by 13.5% and was 1.16±0.06 perf. un. At 4 p.m. mean square deviation (MSD) increased by 21.5% from previous value and became equal to 1.41±0.07 perf. un. At 7 p.m. mean square deviation (MSD) continued to increase and reached 1.74±0.09 perf. un. (increment 23.4%). Maximal MSD value of girls was registered at 11 p.m. – 1.92±0.13 perf. un. (dynamic from previous indicator +10,3%).

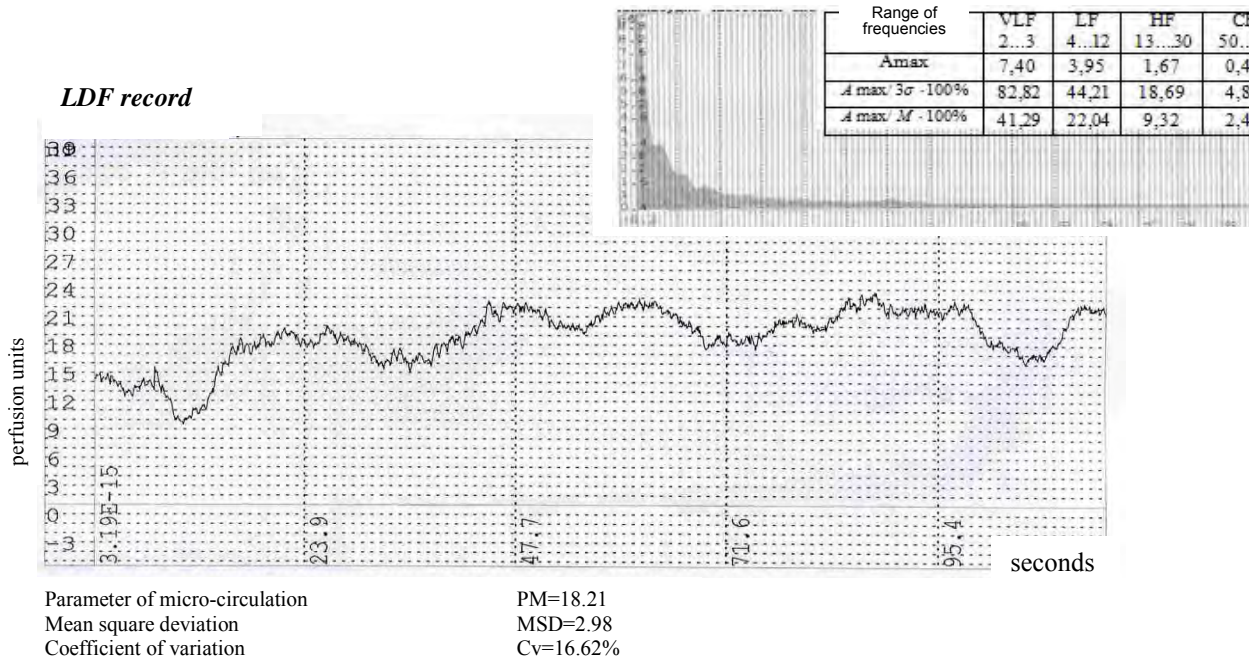


Fig.1. Daily monitoring of LDF record of 17 years old girl with standard type of micro-circulation at 8 a.m.

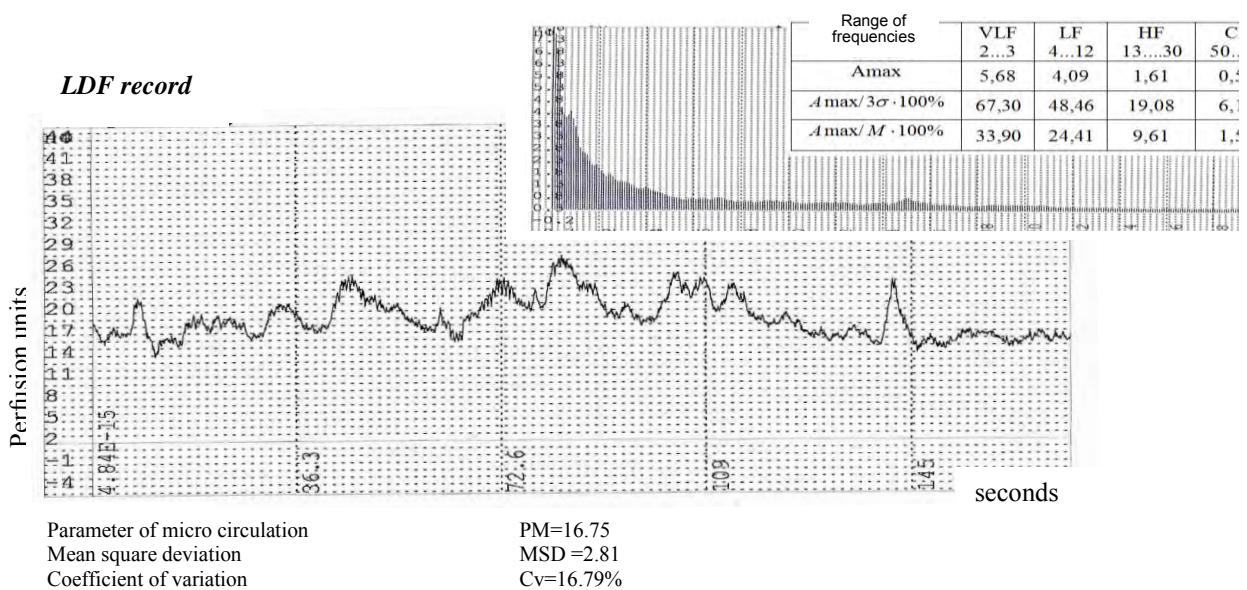


Fig.2. Daily monitoring of LDF record of 17 years old girl with standard type of micro-circulation at 12 a.m.

The received data witness that during day LDF record with a-periodically high amplitude oscillations of tissue blood flow, which are characteristic for standard type, preserves. By 12:00 we registered reduction of micro-circulation parameters and level of mean square deviation. Variation coefficient also reduces. Analysis of amplitude-frequency variations (AFV showed increase of vasomotor oscillations' amplitude (LF oscillations), breathing oscillations (HF) and pulse waves (CF oscillations).

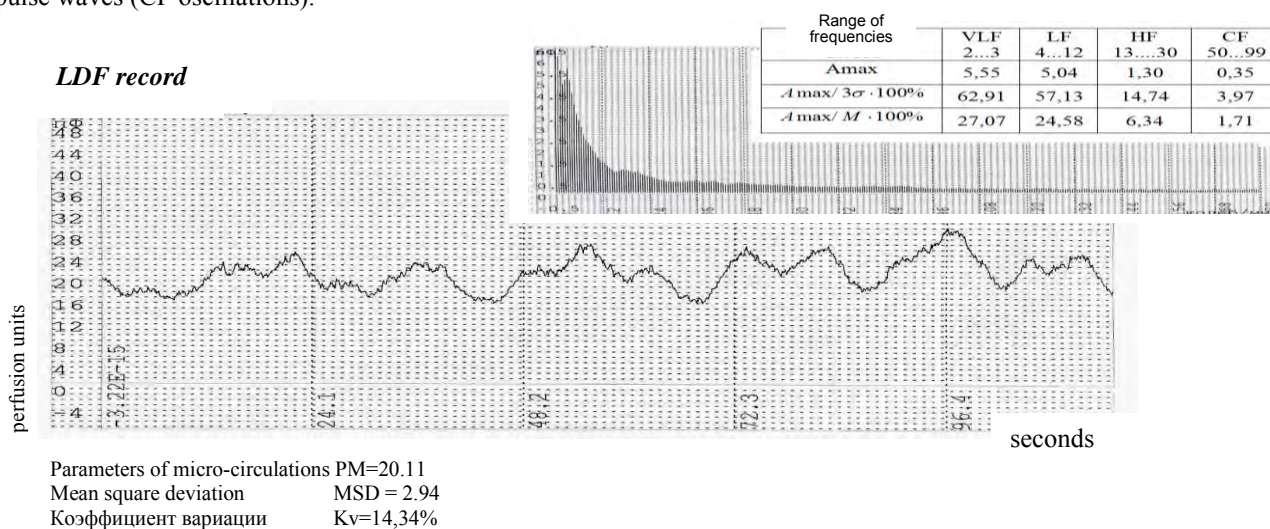


Fig.3. Daily monitoring of LDF record of 17 years old girl with standard type of micro-circulation at 4 p.m.

By 4 p.m. PM and MSD increase. In AFV metabolic component of vasomotor oscillations (VLF rhythm) substantially increases. At evening period PM reduces and MSD (characterizing flux level) significantly rises. Against such background contribution of vasomotor rhythm, breath and pulse oscillations of blood flow increase.

In analysis of rhythmic components of LDF amplitude-frequency spectrum of girl-students we received the following data (see table 1).

Indicators of contribution of metabolic oscillations (VLF-oscillations), vasomotor oscillations) breathe oscillations (HF) and pulse waves (CF oscillations) at 8 and 12 a.m. witness about tension of breathing and pulse components of tissue blood flow's modulations.

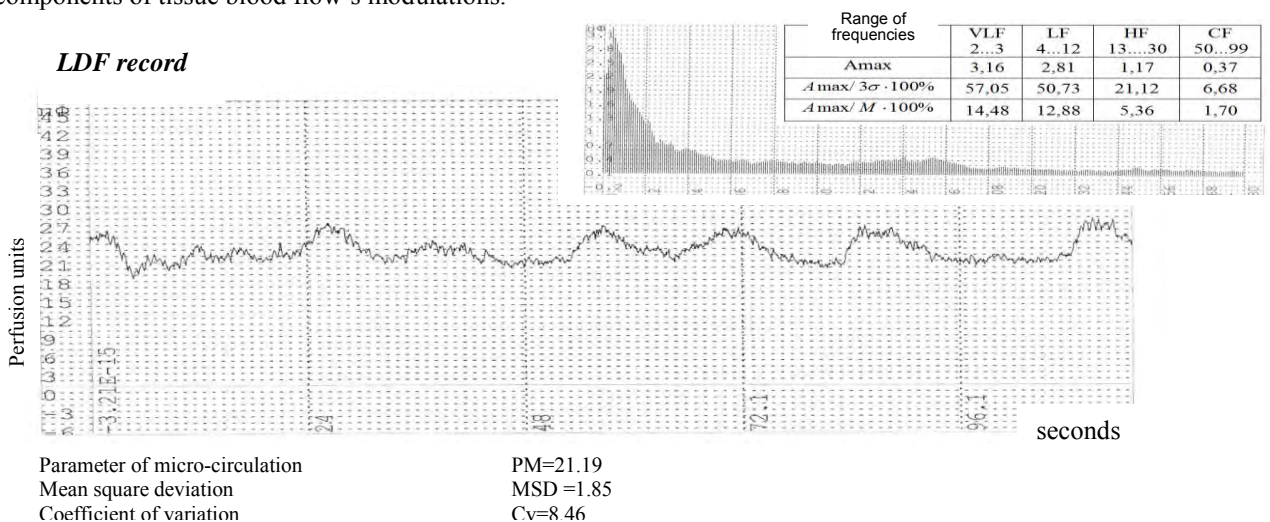


Fig.4. Daily monitoring of LDF record of 17 years old girl with standard type of micro-circulation at 7 p.m.

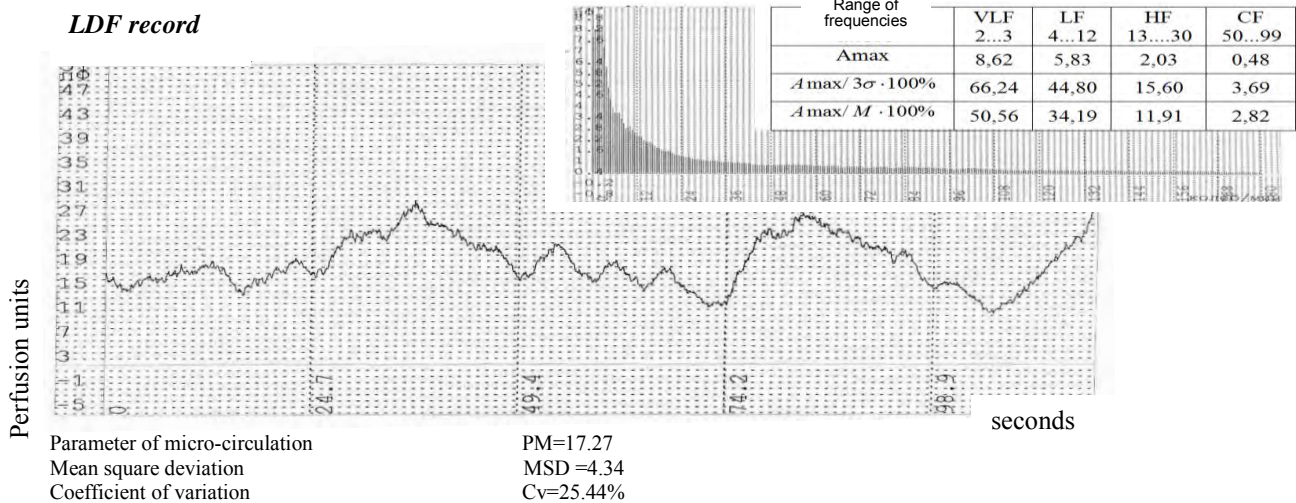


Fig.5. Daily monitoring of LDF record of 17 years old girl with standard type of micro-circulation at 11 p.m.

At 4 p.m. metabolic component of vasomotor activity plays substantial role in modulation of tissue flow's oscillations. At 7 p.m. contribution of LF oscillations reduces. Contribution of HF oscillations increases. Here we see clear compensatory increasing of breathing rhythm, which plays passive role in modulations of tissue blood flow. As 11 p.m. contribution of VLF-oscillations, LF- and HF- oscillations corresponded to values of 8 a.m. In comparison with morning hours it is higher by 50%.

Table 1.

Girls' daily dynamic of contribution of different rhythmic components in tissue blood flow's modulation

AFV parameters	Time of day										
	8:00			12:00		16:00		19:00		23:00	
	Contribution in power of spectrum, %	Contribution in power of spectrum, %	Change from previous value, %	Contribution in power of spectrum, %	Change from previous value, %	Contribution in power of spectrum, %	Change from previous value, %	Contribution in power of spectrum, %	Change from previous value, %	Contribution in power of spectrum, %	Change from previous value, %
VLF-oscillations	56.7±1.2	47.2±0.9*	-6.8	55.3±0.9*	+16.6	57.4±1.2	+3.8	56.8±0.1	-1.1		
LF-oscillations	35.4±1.0	44.3±0.9	+25.0	37.7±0.6*	-14.9	27.8±1.5*	-26.3	35.5±0.8*	+27.6		
HF-oscillations	6.9±0.6	7.3±0.5	+6.6	6.0±0.4	-16.8	7.6±0.8	+26.7	6.4±0.6	-16.2		
CF-oscillations	0.8±0.1	1.1±0.1*	+35.8	0.9±0.1	-10.3	0.9±0.1	-4.1	1.2±0.2	+27.6		

Notes: VLF – metabolic oscillation, LF – vasomotor oscillations, HF – breath oscillations, CF – pulse oscillations; statistically confident between indicators of contribution of different rhythmic components in tissue blood flow's modulation\* –  $p < 0,001$

**Discussion**

As on to day the problem of individual-typological characteristics of blood micro-circulation process is rather urgent as far as any change in organism results in disorder of trans-capillary metabolism. World practice of study of blood micro circulation is based on researches of micro-circulation with pathologies in clinic conditions. Such scientists like Friese R.S., Edwards K.M. [19] research blood micro-circulation with hyper-tension. Mills P.J., Heller M.J.,

Lefkowitz R.B., Schmid-Schönbein G.W. [20, 21] study ferment fractions of blood. Shoucri B.M., Edwards K.M. [23] regard hereditary – determinate parameters of micro-circulation stream.

Blood microcirculation of healthy persons in process of ontogeny is widely studied by Russian scientists: V.I. Kozlov, F.B. Litvin, M.V. Morozov et al. [3, 6, 7, 8]. Their work contain fundamental study of individual-typological characteristics of children's micro-circulation in process of ontogeny; peculiarities of capillary blood flow's reserves of sportsmen, when conducting different functional tests.

In Ukraine researches of myogenic activity of micro-vessel stream of healthy person's skin under influence of low intensive electromagnetic radiation of high frequency, with the help of laser Doppler's flow metering were conducted by N.S. Tribat, Ye.N. Chuyan [17].

At present one of main methods of micro-circulation study is laser Doppler's flow metering (LDF), which is a method of integral, non invasive assessment of micro-circulation haemo-dynamic in tissues and is a reliable method of micro-circulation disorders' diagnostic.

G. Schmid-Schonbein works out conception, according to which oscillations of tissue blood flow are result of superposition of active and "passive" modulations of flux-motions. Disappearing of some or another rhythmic components of flux-motions is interpreted as "spectral narrowing" of LDF record and can serve as diagnostic criterion of disordering of micro-circulation regulation mechanisms [22].

In spite of high interest and urgency of studying of blood micro-circulation processes, as on to day there is no normative indicators of parameters of health persons' tissue blood flow parameters, received with the help of laser Doppler's flow metering (LDF). That is why the purpose of our work was studying of blood micro-circulation parameters of healthy girls in connection with daily bio-rhythms. The observed daily dynamic of micro-circulation indicators in women's organism witnesses about increase of LDF record's indicators in second half of day. Some changes in correlation of rhythmic components of tissue blood flow at the account of weakening of vasomotor rhythm were registered. According to conception of myogenic mechanism (worked out by B. Folkow) spontaneous rhythmic contractions of smooth myocytes are conditioned by increasing of transmural pressure [18]. It witnesses about tension of regulatory mechanisms. The received by us data are in accordance with ideas about changes in vegetative sphere and workability of human organism during day.

Thus, the received data about peculiarities of blood micro-circulation of certain age group girls can be used as normative indicators of LDF metering when studying of pathological processes in medicine.

#### Conclusions:

1. Studying of daily dynamic of girls' micro-circulation showed increase of LDF record's indicators (PM and MSD) in second half of day. Besides, there were registered changes in correlation of rhythmic components of tissue blood flow oscillation at the account of weakening of vasomotor rhythm. It witnesses about tension of regulatory mechanisms in them.

2. In first half of day there is observed tension of micro-circulation regulatory mechanisms, which partially reduces by 4 p.m. at the account of strengthening of metabolic components of vasomotor rhythm.

3. In evening period we observed compensatory strengthening of breath and pulse modulations of tissue blood flow, which were mainly connected with weakening of sympathetic and strengthening of parasympathetic impacts on tissue blood flow.

In the prospect we plan to carry out researches in the field of organism's reserve potentials of girls' daily blood micro-circulation with the help of thermal and cold tests.

#### Conflict of interests

Authors declare that there is no conflict of interests.

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