University of Ljubljana
Faculty of Sport

The effect of an elastic support on the variability of heart rate in sedentary office work

Stanko Štuhec
University of Ljubljana – Faculty of Sport – Institute of Sport

We all know that it is better for our health and well-being to sit upright than slouched. In the morning we are more attentive to maintain our proper posture, but in time, as we become more tired, we find it more difficult to keep our spine erect. Thus, eventually we start to slouch by drooping our pelvis, bending our spine, moving forwards in our seat and leaning our shoulders backwards on the backrest. Long-term negative effects of improper sitting posture reflect in our health and well-being in a form of spinal, thigh, shin and foot pain.

There are many devices in the market that promise us a more ergonomic body position in sedentary office work. In particular, we found the principle of stabilising the lumbar spine by using elastic bands, lumbar support and abdominal supportive accessory very interesting. In providing a more ergonomically correct position of the lumbar spine while sitting, this device uses an additional supportive accessory on the abdomen that somewhat presses the abdominal part and also thoracic diaphragm and thus affects our breathing. Breathing, due to elastic suspension, is supposedly not hindered, but even steadier. From our own research and other studies we know that breathing has a very important role in controlling the heart rate. In the phase of exhalation, the heart rate is decreased, while in the phase of inhalation it increases. Thus, a more even breathing could provide a decrease of heart rate and at the same time an increase of its variability.

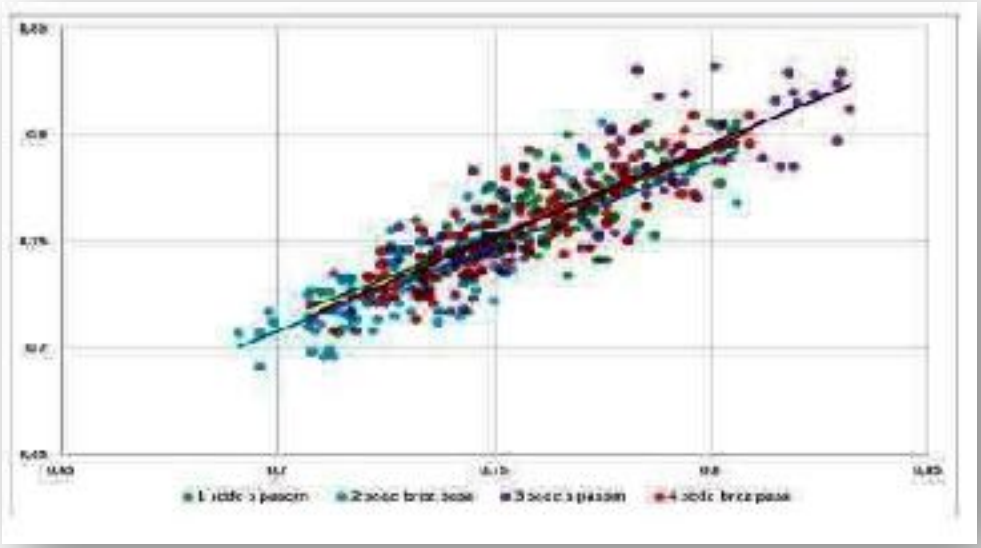

Figure 1: Scatter diagram of differences between successive heartbeats.

	A	B	C	D	Difference A-B	Difference C-D
	1. siting with the belt	2. sitting without the belt	3. sitting with the belt	4. sitting without the belt		
RR (ms)	755.7	732.9	775.8	745.6	-22.8	-30.2
FSU (hb/min)	79.5	81.9	77.4	80.6	2.5	3.1
RMSSD (ms)	14.1	12.4	17.2	12.9	-1.7	-4.24

Table 1: Measured and calculated variables of heart rate.

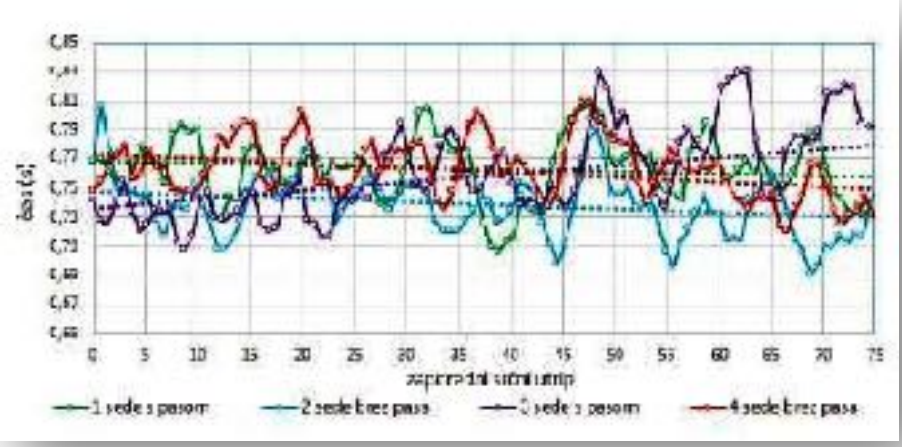

Figure 2: Graphic display of heart rate in time.

To test the above-stated device, we used the technology to analyse the heart rate variability. The measured subject conducted two series of measurements without interruptions. Each series comprised a five-minute sitting with the belt – upright – and a five minute sitting without the belt – slouched. Before that the measured subject sat for five minutes with the belt applied – in the upright position – to establish stable conditions prior to measurement. The precise time breaks between the intervals were provided by a computer program. Of 20 minutes of heart rate measured, 16 minutes were used for the analysis. Of each of four intervals we eliminated 30 seconds at the start and 30 seconds at the end. Thus, we eliminated the effect of the next interval on the measurement results (Figure 1 and 2). After examining and analysing the measured raw data of heart rate, we established that we had measured all heartbeats without leaving out any heartbeat (Figure 3 above). We attribute this to the fact that there are no disturbances in the sedentary position that would decrease the contact surface between the skin and electrodes to measure the heart rate.

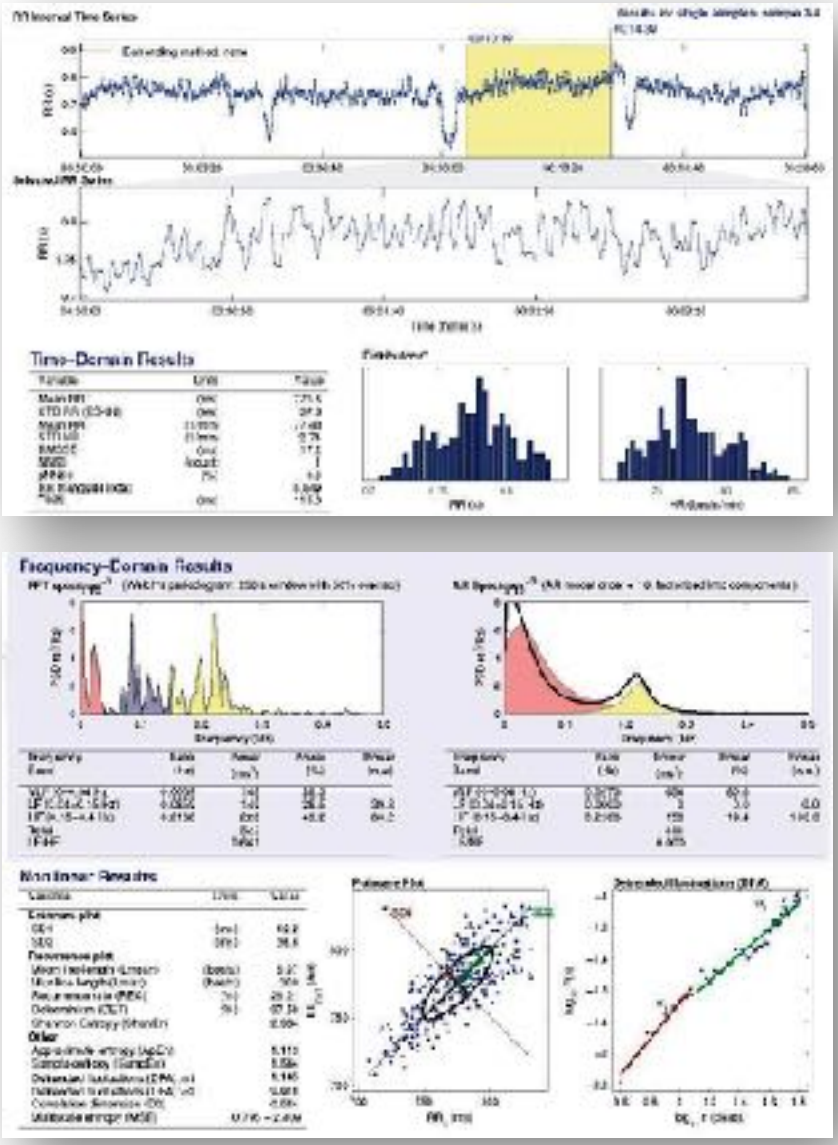

Figure 3: Display of the processing of raw signals of the measured heart rate for the first interval of the second series.

To acquire the heart rate, we used Polar V800 and H7 transmitter. The data was processed with the Kubios HRV v.2.2 software (University of Eastern Finland, May 2014) (Figure 3) and our own software.

The results show that there are unexpected differences in heart rate and variability of heart rate between the intervals with and without the application of belt. The heart rate when using the belt is lower than without it (Table 1). The variability of heart rate is higher when using the belt than without it (Table 1). In further tests we will use more measured subjects and random method to select intervals. Thus, we will provide a double blind study and try to find out whether the differences occur also in this test and whether they are statistically significant.