Respiratory sinus arrhythmia (RSA), the high-frequency component of heart rate variability (HRV), has been linked to vagal-cardiac nerve traffic. Decreased HRV and RSA have been associated with emotional states in depressed patients. Therefore, we hypothesized that phase synchronization between RSA and respiratory movement in major depressive disorder (MDD) with or without suicidal ideation may be different to a control group during a resting mental state.

Diagnoses of MDD were made by the Mini-International Neuropsychiatric Interview (MINI). The subscale (C-Module of MINI) with scores more than 9 of 38 were considered with suicidal ideation (SI). The interbeat intervals (RRI) and respiratory movement were extracted from 10 minutes ECG signals of control subjects (10 CONT), 10 MDD subjects with SI (MDDSI+) and 10 without (MDDSI-).

Both RRI and respiration were resampled at 10 Hz and band passed filtered (0.10–0.4 Hz). Hilbert transform was applied to extract instantaneous phases of the RSA [$\Phi_{RSA}(t_k)$] and respiration [$\Phi_{RESP}(t_k)$]. Then time dependent phase coherence (λ) between RSA and Respiration was obtained by the following equation.

$$\lambda(t_k) = \left| \frac{1}{N} \sum_{j=k-\frac{N}{2}}^{k+\frac{N}{2}} e^{[\Phi_{RSA}(t_k) - \Phi_{RESP}(t_k)] \bmod 2\pi} \right|^2$$

N denotes number of data samples. The λ value ranges from 0(lowest)~1(highest) coupling. HRV indices (LF, HF, LF/HF) were calculated.

Higher breathing frequency [(breaths/min): 20±4 (MDDSI+), 17±2 (MDDSI-), 16±3 (CONT)], and lower amplitude of RSA (ARSA) [(ms): 18±3, 20±1, 24±3], lower λ values [0.51±0.5, 0.54±0.4, 0.71±0.2] and lower HF power [ms2: 402±101, 569±203, 1050±490] were found in the MDDSI+ group compared to the MDDSI- group ($p<0.05$) and CONT group ($p<0.01$). The λ was significantly ($p<0.05$) positively correlated with ARSA ($r=0.65$) and the HF power ($r=0.55$).

In this preliminary study we conclude that the resting mental state in MDD patients exerts an influence on RSA oscillations by decreasing the amplitudes, inducing incoherent phase lag with respect to respiratory movements.