

Deteksi Depresi pada Mahasiswa berdasarkan *Standar Deviation Normal to Normal (SDNN) Heart Rate Variability (HRV)*

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Abstrak

Prevalensi depresi pada mahasiswa yang terus meningkat, disertai keterbatasan metode diagnosis subjektif seperti pengisian skala dan wawancara klinis berbasis *Diagnostic and Statistical Manual of Mental Disorders (DSM)*, mendorong perlunya pengembangan metode deteksi yang lebih objektif. Disregulasi sistem saraf otonom yang terkait dengan depresi dapat diamati melalui *Heart Rate Variability (HRV)*, khususnya indikator *standard deviation of normal-to-normal intervals (SDNN)*. Namun, efektivitas SDNN sebagai penanda fisiologis pada populasi mahasiswa masih memerlukan verifikasi, terutama dalam konteks dinamika adaptif sistem saraf otonom terhadap fase stres dan pemulihan. Penelitian ini bertujuan memverifikasi akurasi SDNN sebagai alat deteksi depresi serta mengeksplorasi fleksibilitas respons otonom pada mahasiswa selama tugas stres kognitif dan fase istirahat. Fitur SDNN dianalisis menggunakan *mixed-design ANOVA* untuk mengevaluasi efek dalam-subjek (fase) dan antar-subjek (kelompok). Evaluasi kemampuan SDNN dalam membedakan mahasiswa depresi dan sehat dilakukan menggunakan model *Neural Network*, yang mampu menangkap hubungan non-linear kompleks antara HRV dan status depresi. Kinerja model dinilai menggunakan akurasi, sensitivitas, dan spesifisitas. Hasil penelitian menunjukkan bahwa SDNN mampu membedakan mahasiswa depresi dan sehat dengan akurasi tinggi (92%) dan *Area Under the Curve* sebesar 0,88. Nilai SDNN yang secara konsisten lebih rendah pada kelompok depresi menunjukkan fleksibilitas otonom yang menurun, ditandai dominasi aktivitas simpatis dan penurunan kronis aktivitas parasimpatis (*vagal tone*). Perbedaan paling signifikan terlihat pada fase pemulihan akhir, yang menunjukkan keterbatasan kapasitas pemulihan otonom (*impaired recovery*). Temuan ini mendukung potensi SDNN sebagai indikator fisiologis yang objektif, non-invasif, dan efisien untuk deteksi dini depresi pada populasi mahasiswa.

Kata Kunci: SDNN, *Heart Rate Variability (HRV)*, Depresi, Sistem Saraf Otonom, Mahasiswa

Detection of Depression in College Students Based on the Standard Deviation of Normal to Normal (SDNN) Heart Rate Variability (HRV)

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Abstract

The increasing prevalence of depression among university students, along with limitations of subjective diagnostic methods such as self-report scales and clinical interviews based on the *Diagnostic and Statistical Manual of Mental Disorders* (DSM), highlights the need for more objective detection approaches. Autonomic dysregulation associated with depression can be observed through heart rate variability, particularly the *standard deviation of normal-to-normal intervals* (SDNN). However, the effectiveness of SDNN as a physiological marker in student populations requires further verification, especially regarding adaptive autonomic responses across stress and recovery phases. This study aimed to verify the accuracy of SDNN as a depression detection tool and to explore autonomic flexibility in students during cognitive stress and rest phases. A total of 73 participants (38 students with depression and 35 healthy students) were involved in a mixed experimental design. SDNN features were analyzed using mixed-design analysis of variance to examine within-subject (phase) and between-subject (group) effects. Classification performance of SDNN for differentiating depressed and healthy students was evaluated using a Neural Network model, which captured complex non-linear relationships between heart rate variability and depression status. Model performance was assessed with accuracy, sensitivity, and specificity metrics. Results showed that SDNN reliably distinguished depressed from healthy students with high accuracy (92%) and Area Under the Curve = 0.88. Consistently lower SDNN values across all phases in the depression group indicated reduced autonomic flexibility, characterized by sympathetic dominance and chronically diminished parasympathetic activity. The most pronounced difference occurred in the final recovery phase, indicating impaired autonomic recovery. These findings support SDNN as an objective, non-invasive, and efficient physiological indicator for early depression screening in university student populations.

Keywords: SDNN, *Heart Rate Variability* (HRV), Depression, Autonomic Nervous System, College Student