ORIGINAL RESEARCH

Cardiac autonomous activity of malnourished and healthy children

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ABSTRACT
Background: The autonomic nervous system (ANS) is a complex network of nerves and ganglia that regulates involuntary functions of the body, including heart rate, blood pressure, digestion, respiratory rate, and glandular secretion. The present study was conducted to assess cardiac autonomous activity of malnourished and healthy children. **Materials & Methods:**45 malnourished (Group I) and 45 healthy children (Group II) of both genders were selected. Anthropometry, basal heart rate (BHR), blood pressure was determined. Time domain and frequency domain indices of HRV were assessed using RMS Polyrite D. **Results:** In group I and group II, body weight (kg) was 15.4 and 28.2, mean height (cm) was 106.3 and 120.4, MAC (cm) was 14.2 and 19.5, BMI (kg/m2) was 13.8 and 17.2, BHR (per min) was 87.4 and 84.2, systolic BP (mmHg) was 98.4 and 99.2 and diastolic BP (mm Hg) was 65.2 and 68.2 respectively. The difference was significant ($P < 0.05$).SDNN (ms) was 117.5 and 124.9, RMSSD (ms) was 59.5 and 52.3, pNN50 (%) was 34.8 and 28.5, LF (nu) was 47.4 and 32.9, HF (nu) was 53.8 and 65.2 and LF-HF ratio was 0.98 and 0.62 in group I and group II respectively. The difference was significant ($P < 0.05$). **Conclusion:** Children suffering from mild to severe malnutrition may experience decreased cardiac autonomic nerve function, which is characterized by sympathetic overactivity. MAC outperformed BMI as an HRV correlate.
Keywords: autonomic nervous system, malnourished, Time domain

INTRODUCTION

The autonomic nervous system (ANS) is a complex network of nerves and ganglia that regulates involuntary functions of the body, including heart rate, blood pressure, digestion, respiratory rate, and glandular secretion.[1] It is responsible for maintaining homeostasis and coordinating physiological responses to internal and external stimuli without conscious effort. The ANS operates automatically, controlling vital functions that are essential for survival and adaptation to changing environmental conditions.[2,3]
It has been shown that children who are malnourished have a severely impaired autonomic nerve system (ANS).Evidence suggests that widespread dysautonomia is caused by marginal high calorie malnutrition, specifically with regard to simple carbs, in addition to genetically and epigenetically established diseases.[4] The organs with the fastest rates of oxidative metabolism are the heart and brain, which are also the first to be impacted by any process that lowers oxidative efficiency.The hypothalamic/autonomic/endocrine axis is thought to become disordered as a result.[5] Heart rate and its variations are indicative of changes in cardiac autonomic regulation because of the strong relationship between the ANS and the sino-atrial node's function. HRV is a non-invasive ECG indicator that shows how the heart's sinus node is being used by the sympathetic and vagal branches of the ANS.[6]The present study was conducted to assess cardiac autonomous activity of malnourished and healthy children.

MATERIALS & METHODS

The present study consisted of 45 malnourished (Group I) and 45 healthy children (Group II) of both genders. All gave their written consent to participate in the study.
Data such as name, age, gender etc. was recorded. A thorough history and complete clinical examination was done in all children. Mercury sphygmomanometer with appropriate cuff size was used for recording basal blood pressure.Grading of malnutrition was done according to Indian Academy of Pediatrics (IAP) classification. Anthropometry, basal heart rate (BHR), blood pressure was

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determined. Time domain and frequency domain indices of HRV were assessed using RMS Polyrite D.

Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS
Table I Assessment of parameters

Parameters	Group I	Group II	P value
Body weight (kg)	15.4	28.2	0.01
Height (cm)	106.3	120.4	0.03
MAC (cm)	14.2	19.5	0.05
BMI (kg/m2)	13.8	17.2	0.02
BHR (per min)	87.4	84.2	0.19
Systolic BP (mmHg)	98.4	99.2	0.35
Diastolic BP (mmHg)	65.2	68.2	0.82

Table I, graph I shows that in group I and group II, body weight (kg) was 15.4 and 28.2, mean height (cm) was 106.3 and 120.4, MAC (cm) was 14.2 and 19.5, BMI (kg/m2) was 13.8 and 17.2, BHR (per min) was 87.4 and 84.2, systolic BP (mmHg) was 98.4 and 99.2 and diastolic BP (mmHg) was 65.2 and 68.2 respectively. The difference was significant (P< 0.05).

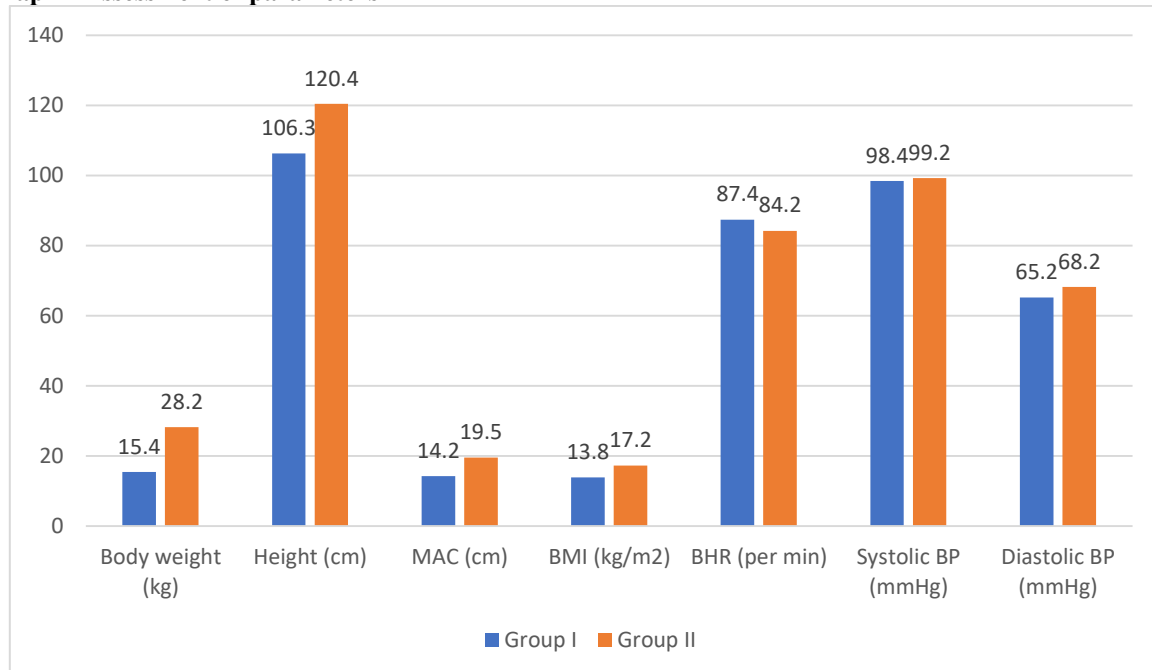**Graph I Assessment of parameters**

Table II Time domain and frequency domain indices of spectral HRV analysis in both groups

Parameters	Group I	Group II	P value
SDNN (ms)	117.5	124.9	0.52
RMSSD (ms)	59.5	52.3	0.61
pNN50 (%)	34.8	28.5	0.25
LF (nu)	47.4	32.9	0.05
HF (nu)	53.8	65.2	0.02
LF-HF ratio	0.98	0.62	0.01

Table II shows that SDNN (ms) was 117.5 and 124.9, RMSSD (ms) was 59.5 and 52.3, pNN50 (%) was 34.8 and 28.5, LF (nu) was 47.4 and 32.9, HF (nu) was 53.8 and 65.2 and LF-HF ratio was 0.98 and 0.62in group I and group IIrespectively. The difference was significant (P< 0.05).

DISCUSSION
The sympathetic division is often referred to as the "fight or flight" system because it prepares the body for action in response to perceived threats or stressors.[7]Sympathetic nerves originate from the thoracic and lumbar regions of the spinal cord.Activation of the sympathetic system leads to increased heart rate, dilation of the pupils, bronchodilation, mobilization of energy stores, and inhibition of digestion and urinary function.[8,9]The parasympathetic division is sometimes called the "rest and digest" system because it promotes relaxation,

rest, and conservation of energy.[10]Parasympathetic nerves originate from the brainstem and sacral region of the spinal cord.Activation of the parasympathetic system leads to decreased heart rate, constriction of the pupils, stimulation of digestion and urinary function, and relaxation of smooth muscles.[11,12]The present study was conducted to assess cardiac autonomous activity of malnourished and healthy children.

We found that in group I and group II, body weight (kg) was 15.4 and 28.2, mean height (cm) was 106.3 and 120.4, MAC (cm) was 14.2 and 19.5, BMI (kg/m2) was 13.8 and 17.2, BHR (per min) was 87.4 and 84.2, systolic BP (mmHg) was 98.4 and 99.2 and diastolic BP (mm Hg) was 65.2 and 68.2 respectively. Srivastava et al[13] in their study 35 malnourished children (mean age: 6.06±2.04years), on the basis of anthropometric parameters, were enrolled in the studygroup by random samplings, who were the children of urban slum dwellersand 35 age and sex matched healthy children, were taken as controls.Weight, height, mid armcircumference (MAC) and body mass index (BMI) were found to bestatistically lower in the study group. There was a strong negativecorrelation between MAC and LF component (P<0.01). BHR was found tobe increased in the malnourished group (P=0.027). Low frequency (LFnu)& LF-HF ratio were found to be increased (P=0.000 & P=0.001 respectively)while high frequency (HFnu) component was decreased (P=0.000) inmalnourished group.

We found that SDNN (ms) was 117.5 and 124.9, RMSSD (ms) was 59.5 and 52.3, pNN50 (%) was 34.8 and 28.5, LF (nu) was 47.4 and 32.9, HF (nu) was 53.8 and 65.2 and LF-HF ratio was 0.98 and 0.62 in group I and group II respectively. Bedi et al[14] in their study autonomic function tests were conducted in 30 normal subjects and 30 malnourished children aged between 5 and 10 years. The tests performed included tests for parasympathetic functions (resting heart rate, standing-to-lying ratio, lying-to-standing ratio and Valsalva ratio) and tests to assess sympathetic function (hand grip test, galvanic skin resistance). The malnourished children had significantly lower mean weights-for-age (-2.6 Z vs -1.5 Z; p = 0.001), heights-for-age (-2.5 Z vs -1.5 Z; p = 0.001) and weights-for-height (-1.6 Z vs -0.8 Z; p = 0.001). Parasympathetic function tests evaluated were significantly affected in malnourished children. Resting heart rate was significantly higher in the malnourished group (90.6 vs 82.5/min; p = 0.001). The other parasympathetic function tests had significantly lower mean values than in the control group, namely, standing-to-lying ratio (1.25 vs 1.32; p = 0.026), lying-to-standing ratio (1.23 vs 1.29; p = 0.021) and Valsalva ratio (1.26 vs 1.28; p = 0.037). Of the sympathetic function tests conducted, there were no differences between the two groups for hand grip test but galvanic skin resistance was significantly higher in the malnourished subjects (190.1 vs 149.73; p = 0.001).

The limitation of the study is the small sample size.

CONCLUSION
Authors found that children suffering from mild to severe malnutrition may experience decreased cardiac autonomic nerve function, which is characterized by sympathetic overactivity. MAC outperformed BMI as an HRV correlate.

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