Role of autonomic nervous system in body weight regulation. Bray has proposed the MONA LISA hypothesis, an acronym for Most Obesities kNown Are Low In Sympathetic Activity indicating that obesity is associated with a relative or absolute reduction in the activity of the thermogenic component of the sympathetic nervous system. Since the beta 3-adrenergic receptor plays a significant role in the control of lipolysis and thermogenesis in brown adipose tissue through autonomic nervous system (ANS) activity, we first determined the prevalence of the polymorphism in 204 subjects [Shihara et al., 1999, 2001]. Results indicated that the subjects with the variant, even the heterozygotes, demonstrated significantly lower resting ANS activity than normal subjects, whereas the clinical characteristics did not differ between groups.

Our subsequent studies [Matumoto et al., 1999; Nagai et al. 2000] strongly support the MONA LISA hypothesis and further suggest that obese individuals may show much lower autonomic responsiveness against thermogenic perturbations such as acute cold exposure and diet-induced thermogenesis. Our data also suggest that obese children, as well as adults, possess both reduced sympathetic and parasympathetic nervous activities as compared to lean individuals [Nagai and Moritani, 2004].

Exercise training and autonomic nervous system. We examined the acute effects of aerobic exercise upon sympatho-vagal activities, beta-endorphin, atrial and brain natriuretic peptides (ANP and BNP), and EEG. Measurements consisted of beat-by-beat systolic and diastolic blood pressures (SBP and DBP) and cardiac sympatho-vagal activities by means of ECG R-R interval power spectral analysis. Results suggested that moderate exercise could bring about post-exercise hypotension by modulating natriuretic peptides and beta-endorphin levels with subsequent changes in autonomic nervous system and brain EEG alpha-wave activities.

We also investigated the effects of long-term physical training on ANS in 305 school children (20 min/day, 5 times/wk for 12 month) [Nagai et al. 2004] and 18 obese middle-aged individuals (30 min/day, 3 times/wk, for 12 wks) [Amano et al. 2001]. Results indicated that long-term exercise, even for 20 min a day with mild intensity, could significantly improve both the sympathetic and vagal nervous system activities of the children with initially lower HRV. Similarly, the exercise training resulted in a significant decrease in body mass, BMI, and % fat together with a significant increase in the aerobic working capacity (anaerobic threshold). Total cholesterol, LDL-C, and leptin were also significantly decreased after exercise training. Our power spectral data indicated that the sympatho-vagal frequency component and total power were significantly increased after training, suggesting a strong possibility of enhanced the ANS activities with regularly performed exercise train-