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A study of sympatho-autonomic nervous function with reference to body mass in young adult women

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Abstract
Body mass increase in youth is generally ignored as threat to cardiovascular health, and that is investigated in this study. Study was conducted in young female medical students of 18 to 20 year age with normal or obese body mass. Baseline blood pressure profile as well as Isometric hand grip exercise induced blood pressure response was studied as parameter, to examine cardiovascular risk. In comparison to normal weight subjects, the obese subjects exhibited higher baseline blood pressure profiles but decreased activation of sympathetic system in response to exercise measured as rise of diastolic blood pressure. Sympathetic autonomic nervous system dysfunction was found even among young obese subjects. The observation calls for serious cognizance of obesity as cardiovascular risk even in young, with due interventions and care.

Keywords: Obesity; Autonomic dysfunction; Handgrip test

Introduction
Body mass index is important indicator of balance between energy intake and expenditure. An important regulator of the balance is autonomic nervous system. Parasympathetic system supports conservation while sympathetic system facilitates expenditure of energy. Reduced autonomic regulation is reported to be involved in causation and maintenance of obesity (1). Asian people are found to be more susceptible to obesity related cardiovascular risk compared to other at matched body mass indices (2-4). Depressed sympathetic activity would hamper thermo-genesis, because positive energy balance and weight gain. An excessive sympathetic activity may be implicated in obesity induced hypertension (5). Adipose tissue has endocrine potential releasing substances that may modulate central nervous functions including sympathetic discharge. Such interaction is subject to gender differences and women carry lower sympathetic nervous activity profiles (6). The accumulated knowledge of above perspectives was put to evaluation in 18-20 year old first year female medical students of 2014 admission batch at AIIMS, Bhopal.

Subjects and method
Study was carried out with informed consent from participants and permission from superior authority. The height and weight of participants was recorded to determine body mass index (BMI) by Quetlets formula BMI kg/M^2 = weight in kg/height in $meters^2$. Ladies with BMI between 18.5 to 22.9 were included in normal BMI group as control. Those having BMI $25kg/m^2$ and above were studied as obese group. In all 30 subjects 17 control and 13 obese, all between 18 to 20 year age were chosen after exclusions based on presence of any chronic disease or continuing drug treatment, any habit of tobacco or alcohol or even more than three drinks of tea/coffee per day. The participants were explained about and made conversant with the handgrip test and procedure.

Sympathetic autonomic nervous function test was carried out in same room of the department, quiet, ventilated and with a bed and comfortable armed chairs. The subjects were told to present at least 5 days before or after the menstrual period, without doing any strenuous work and on having good sleep over preceding 24 hours. The tests were completed in October-November 2014 between 9:00 am to 11:00 am in morning, at ambient temperature around 27-28 °C. The subject rested as per choice in bed or in chair for 10 minutes and then blood pressure in sitting position was recorded with digital BP equipment.

For the hand grip test (HGT), subject was instructed to grip the handgrip dynamometer with dominant hand exercising maximum contractile power. Maximum recorded force was noted. The subject was allowed to relax another 5 minutes at this stage. She then had to grip the handgrip dynamometer in sustained fashion for 2 minute period, exerting only 30% of her recorded maximum power, while maintaining normal breathing. At completion of 2 minutes of the test, sitting blood pressure was recorded again. Selective rise in diastolic blood pressure was determined as difference from baseline blood pressure value. An expected normal rise of diastolic blood pressure following HGT was 16 mm or more. Lower rises between 15mm to 11 mm were taken as indicators of borderline sympathetic function/dysfunction. Lesser rise of 10 mm and under was reckoned as distinct abnormal response to hand grip test (7).

Observations and result
Blood pressure profiles at baseline and post HGT in study groups of women (Mean ± SEM):

Parameters	Normal BMI (n=17)	BMI ≥ 25 (n=13)	P value
Mean BMI	20.23 ± 1.96	26.2 ± 3.1	0.1
Baseline Blood Pressure (mmHg)			
Systolic	110.06 ± 6.7	120.2 ± 7.3	0.3

Diastolic	71.04 ± 5.1	77.6 ± 4.8	0.3
Post HGT Blood Pressure (mmHg)			
Systolic	123.6 ± 6.9	127.8 ± 9.8	0.7
Diastolic	85.7 ± 5.4	84.6 ± 7.9	0.9
Difference in Blood Pressure from baseline to post HGT (mmHg)			
Systolic	13.4 ± 2.8	7.6 ± 4.4	0.2
Diastolic	15.3 ± 2.4	6.0 ± 3.2	0.02

The systolic as well as diastolic baseline blood pressure profile is marginally higher in the obese group compared to the normal BMI group. The difference is blunted following HGT isometric exercise. The normal weight group exhibits more marked increase of blood pressure from baseline values post HGT. The obese group shows much less increase in blood pressure, quite distinctly. Most significant are the difference between two groups with respect to post exercise rise of diastolic blood pressure.

Discussion

Handgrip is isometric exercise produced stress. The stress increases sympathetic discharge in cardiac sympathetic nerves as well as in those supplying vasculature (8). Similar results in similar age mixed gender study have been reported earlier (9). High baseline blood pressure in obese individuals is attributed to higher cardiac output imposed by circulation in added adipose tissue and the higher level of sympathetic autonomic nervous tone (10).

Rise in diastolic blood pressure during HGT is significantly blunted in obese subjects. Isometric exercise of HGT essentially invokes increased heart rate dependant increase in cardiac output and blood pressure. There is little change in peripheral resistance. In fact peripheral response to sympathetic activation may be reduced (11). Reduced sympathetic activation may further compromise thermo-genesis and promote positive energy balance and weight gain (5). The locus of defect in sympathetic autonomic nervous function may be in the central outflow or in peripheral responsiveness due to alterations in receptor kinetics and/or dynamics (12).

The study subjects were quite young and findings therefore reveal that obesity associated sympatho-autonomic nervous dysfunction stats quite early. The obese subjects are thus more prone to acquire hypertension and associated cardiac morbidities in later life, than non-obese counterparts. The simple physiological test reveals state of sympathetic nervous disorder and can serve as easy alert to timely interventions for prevention of obesity associated cardiovascular consequences, to large extent.

Conflict of interest statement

There is no conflict of interest.

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