Original Article

Correlation of obesity indices with heart rate recovery as a marker of autonomic function in healthy young adults

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Abstract

Introduction: Obesity has become a challenge for global public health. The global prevalence of obesity has nearly doubled in the past decades (World Health Organization). Obesity may lead to changes in the sympathetic regulation of cardiovascular function, thus favoring the development of cardiovascular complications. **Aim:** To find a correlation between various obesity indices (body mass index, waist-height ratio, waist circumference and waist-hip ratio) and heart rate recovery in healthy subjects. **Materials and Methods:** A total of 100 apparently healthy subjects aged 18–30 years were enrolled and were divided into two groups on the absence and presence of a family history of cardiovascular disease. The treadmill testing was done in the exercise lab of the physiology department of the medical institute. Exercise testing of the subjects was conducted according to the standard Bruce protocols. **Results:** There was a negative correlation between various obesity indices and heart rate recovery but we did not get a statistically signification association between them. **Conclusion:** In our study, we have found no statistically significant association between various obesity indices and heart rate recovery. Thus measuring obesity indices in the younger age group will not lead to much significance in terms of heart rate recovery and may be avoided.

Keywords: Heart Rate Recovery, Obesity indices, Young Adults

Introduction

Our body responds in a number of ways to exercise. One such way is the increase in heart rate with the exercise which then returns to its initial level after the cessation of exercise. The rate at which heart rate returns to the pre-exercise level is called heart rate recovery (HRR). A low value for heart-rate recovery after exercise testing, which has been previously shown to be a marker of decreased vagal activity, is a powerful and independent predictor of the risk of death.[1] Cardiovascular diseases are major complications of delayed HRR and obesity. Measuring obesity indices may be a useful way to predict changes in HRR so that proper screening could be done in those who are in the high-risk group.

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Previous studies have shown that early HRR after dynamic exercise is mainly a function of vagal reactivation, with the sympathetic withdrawal becoming important later in recovery.[2,3]

A delayed HRR is, therefore, considered a measure of autonomic imbalance and may be an indicator of a reduction in vagal tone or an exaggerated sympathetic activation.[2,4]

Weight loss and fitness gains were associated with greater improvements in HRR.[5] Obese individuals present with vagal nerve dysfunction and there is an inverse relationship between body mass index (BMI) and HRR.[6] There are many obesity indices that are used to categorize healthy and obese persons. One of the best obesity indexes is BMI because it approximates adiposity and fat distribution in adults.[7] Previous studies have shown a significant association of HRR with BMI and waist circumference (WC).[8,9] WC is considered the best index of abdominal visceral adipose tissue and may also be the best index

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for predicting cardiovascular risks.[10-13] Waist-to-hip ratio (WHR) is a simple anthropometric index used as a tool to assess central fat distribution or abdominal adiposity and associated with cardiovascular diseases.[7,11] Since cardiovascular diseases and mortality are major complications of obesity and delayed HRR, an ideal obesity parameter should predict changes in HRR to facilitate further screening and treatment decisions.

There has been a study that has shown a significant correlation between obesity indices and heart rate recovery even in healthy nonobese individuals but the study was conducted on a very large age group individuals (18–66 years).[14] Furthermore, autonomic recovery following aerobic exercise in healthy men with different waist-stature ratio (WSR) values was studied and healthy men with higher WSR accomplished delayed autonomic recovery following maximal effort exercise.[15] A similar study showed obese sedentary young men achieved significant improvements in vagal activity, adiposity indices and aerobic fitness after the exercise training. The higher reduction in fat mass, especially central obesity, was associated with greater alteration of vagal modulation.[16]

It is very clear from the above information that obesity indices have a significant correlation with autonomic function. We undertook this study to see at what age these obesity indices start affecting the autonomic function since the above studies have failed to highlight the same. We believe that in very young individuals (<30 years in our study) measuring obesity indices will not give us much information about the autonomic functions and that it is actually in the older age group they start showing significant association with each other.

Thus our study adds more information to the work already undertaken by many authors.

Materials and Methods

Ethics- Written informed consent was gained from each participant and ethical approval was granted by the research ethics committee of the university (94thECM II B-Thesis-P/8).

Study design

Selection and description of participant—All the subjects enrolled for the study were undergraduate students who belonged to medical, dental and nursing fraternity**.** It was a cross-sectional observational study. The study was conducted upon a total of 100 individuals aged 18–30 years of either sex fulfilling the criteria set for the study. Before enrolment, all subjects were assessed based on clinical history, local, and systemic examination. All the subjects enrolled were divided into two groups based on the presence or absence of a family history of cardiovascular disease in first-degree family members. The participants were university students aged between 17 and 30 years. Subjects having a history of any acute or chronic illness, chest deformity, diabetes, hypertension, any known cardiorespiratory disease or insufficiency, hemoptysis of unknown origin, any surgery/injury to the thorax or abdomen were excluded. A Pro Bodyline treadmill was used for the exercise testing which was conducted according to the Bruce protocol. A target heart rate was calculated according to the formulae 220-Age. Achievement of the target heart rate was considered to be the point for termination of exercise testing. Despite our best efforts some of the subjects could not achieve the target heart rate.

The subject's height was measured to the nearest 0.1 cm with a stadiometer. Weight was measured to the nearest 0.1 kg in light clothing without shoes using a standard scale. BMI was calculated as weight (kg) divided by height squared (m^2). Waist and hip circumferences were measured twice to the nearest 0.1 cm using an inelastic and flexible tape, on a horizontal plane at the end of normal expiration with subjects lightly clothed and standing. WHR was calculated by the formula: WHtR = WC/Height.

Statistics

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical Analysis Software. The Pearson correlation coefficient was used to determine the correlation of heart rate recovery with various obesity indices. The multivariate regression analysis was used to identify the independent and confounding variables.

Results

There was a negative correlation between various obesity indices in subjects belonging to both groups. The correlation found between these parameters exhibited nonsignificance in both the groups ($P > 0.05$) [Table 1]. There was also no statistically significant difference between the age group [Table 2] with the mean age of 22.12 years [Table 2] and 21 years [Table 2]. Subjects were gender-matched [Table 2]. No obesity indices showed a significant difference between the two groups [Table 2].

Discussion

The principal findings of the present study indicated that (a) HRR was independently associated with WHR, WC, WHtR, and BMI; and (b) of the four obesity indices studied, none of them were found to have a statistically significant correlation with HRR [Table 1].

Table 1: Correlation between obesity indices and heart rate recovery (beats/min)

	Positive family history (Gr2)		Negative family history (Gr1)	
	Correlation coefficient	*P*	Correlation coefficient	*P*
BMI	−0.084	0.608	−0.144	0.272
WHR	−0.078	0.630	−0.10	0.437
WHtR	−0.056	0.732	−0.13	0.313
WC	−0.134	0.407	−0.166	0.20

BMI: Body mass index; WHR: Waist hip ratio; WHtR :Waist height ratio; WC: Waist circumference

Table 2: Comparison of demographic profile of negative and positive family history of cardiovascular disease

	Group 1		Group 2		[1]*p*
	N	%	N	SD	
Gender					
Male	42	70%	26	65%	
Female	18	30%	14	35%	0.604
	Mean	±SD	Mean	±SD	
Age (Years)	22.12	2.85	21.00	2.17	
Waist (cm)	81.95	7.16	81.44	7.03	0.724
Hip (cm)	91.31	6.58	91.97	6.82	0.628
BMI (kg/m^2)	21.65	2.88	21.32	2.66	0.560
WHR	0.89	0.05	0.88	0.06	0.242
WHtR	0.50	0.04	0.51	0.05	0.160

It has been shown that HRR after exercise is a risk factor and thus carries a prognostic significance for cardiovascular mortality.[1] Likewise, obesity has been identified as a major risk factor for cardiovascular diseases.[17] It has been shown that a decline in weight leads to significant improvement in HRR, thus implying that HRR may be modified by losing weight.[9]

We associated BMI, WC, WHtR, and WHR with HRR, an established risk factor for cardiovascular function. Our data indicated that HRR was negatively associated with the four obesity indices.

In conclusion, our data indicate that all the obesity indices were negatively correlated with the heart rate recovery but we could not get a statistically significant correlation between them. Our findings are contrary to the abovementioned works. The reason for the above differences could be due to the small sample size and very young subjects enrolled in our study hence similar study should be done on a larger sample size in middle-aged subjects.

The importance of our study lies in the fact that although obesity indices are proven to be a good reflector of heart rate recovery and thus can predict the future risk of cardiovascular disease, they may not be of equal importance in the younger population age group.

Thus measuring obesity indices in the younger age group will not lead to much significance in terms of heart rate recovery and may be avoided.

Our study carries important significance when it comes to primary care as it gives us an insight into how soon the obesity manifestations will develop and accordingly primary prevention can be done although more studies would be needed to confirm our results.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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