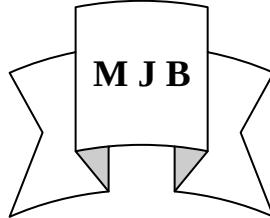


Correlation of Body Mass Index (BMI) With Cardiac and Ventricular Repolarization Parameters in Young Healthy Students

Affan Ezzat Hassan

Dept. of Physiology, College of Medicine, University of Baghdad, Baghdad, Iraq.

Email:affanezat71@yahoo.com



Abstract

Background: Recently, increased frequency in cardiovascular events was observed in young population. It has not been clearly determined whether cardiac and ventricular repolarization parameters differ between the young who have normal body mass index (BMI) and the young who are in overweight BMI class.

Subjects and Methods: Forty-Three overweight (BMI- 28.6 ± 1.2 kg/m², mean age- 20.6 ± 1.5 years) and 39 normal weight (BMI - 21.8 ± 2.0 kg/m², mean age - 20.4 ± 1.4 years) healthy male students from Baghdad University/ Medical College participated voluntarily in this study. All subjects underwent a blood pressure measurement and an electrocardiography recording.

Results: Significant statistical differences in systolic blood pressure, diastolic blood pressure, Q-T interval duration and corrected Q-T interval duration between subjects with normal weight and those with overweight was found, also a positive linear correlation between BMI and Q-T interval duration and corrected Q-T interval duration and systolic and diastolic blood pressure.

Conclusion: Results of this study indicate that the problem of overweight in youngmen should not be ignored. In a younger agegroup, weight gain and a higher BMI may affect cardiac and ventricular repolarization parameters, even if there are no obesity related disorders, such as diabetes, hypertension, and coronary artery disease.

علاقة دالة كتلة الجسم مع مؤشرات إعادة الاستقطاب البطيني و القلبي لدى الطلبة الشباب

الإصحاء

الخلاصة

الخلفية العلمية: في الآونة الأخيرة لوحظ ازدياد في حدوث الأمراض القلبية الوعائية لدى السكان الشباب. ليس من الواضح ان كانت مؤشرات إعادة الاستقطاب البطيني و القلبي تختلف بين الشباب ذوي دالة كتلة الجسم الطبيعية او الشباب ذوي دالة كتلة الجسم العالية.

الأشخاص و طرق العمل: ثلاثة و اربعون شابا من ذوي دالة كتلة الجسم العالية بالإضافة الى تسعة و ثلاثون شابا من ذوي دالة كتلة الجسم الطبيعية من طلبة كلية الطب /جامعة بغداد الإصحاء شاركوا بصورة طوعية في هذه الدراسة . كل الأشخاص خضعوا الى قياس ضغط الدم و اجري لهم فحص تخطيط كهربية القلب.

النتائج: اظهرت نتائج الدراسة وجود فرق احصائي يعتد به في ضغط الدم الانقباضي و الانبساطي و فترة كيو تي و فترة كيو تي المصححة بين الأشخاص ذوي دالة كتلة الجسم العالية و الطبيعية. كذلك اظهرت وجود علاقة خطية موجبة بين دالة كتلة الجسم و فترة كيو تي و فترة كيو تي المصححة ، كذلك وجود علاقة خطية موجبة بين دالة كتلة الجسم و ضغط الدم الانقباضي و الانبساطي.

الاستنتاج: نتائج الدراسة تؤشر ان مشكلة ازدياد الوزن لدى الشباب يجب ان لا تهمل. في فئة الشباب ازدياد الوزن مع ازدياد دالة كتلة الجسم قد يؤثر على مؤشرات مؤشرات إعادة الاستقطاب البطيني و القلبي على الرغم من عدم وجود مضاعفات البدانة كارتفاع ضغط الدم او داء السكري او مرض قصور الشرايين التاجية للقلب.

Introduction

World Health Organization estimates that there are about 180 million obese adults, and at least twice as many adults who are overweight, with a BMI of 25.0 to 29.9.[1]

Recently, increased frequency in cardiovascular events was observed in young population. The reason for increasing incidence of cardiovascular events is not known. It has not been clearly determined whether cardiac and ventricular repolarization parameters differ between the young who have normal body mass index (BMI) and the young who are in overweight BMI class.[2]

Several conventional risk factors, including hypertension, hyperglycemia, and hyperlipidemia, are commonly present in obese patients. Furthermore, sudden cardiac death may also occur in this patient group before the development of heart diseases. It has been shown that obesity is an independent risk factor, and it increases coronary mortality when evaluated together with other coronary risk factors. It has been demonstrated that coronary mortality increases with a higher BMI both in men and women.[3]

Obesity is associated with a wide variety of electrocardiographic (ECG) abnormalities. Most of these reflect alterations in cardiac morphology. Some serve as markers of risk for sudden death. [4].

The body mass index or BMI, is body weight (in kg) divided by height (in m²) this measure is promulgated by the World Health Organization as the most useful epidemiological measure of obesity, it's positively and independently associated with morbidity and mortality from hypertension, cardiovascular disease, type II diabetes mellitus and other chronic diseases.[5]

The objectives of the present study; was to investigate the cardiac parameters including (systolic & diastolic blood pressure) and ventricular repolarization parameters including QT interval duration and its heart rate-corrected value of QTc in overweight and normal weight healthy young male subjects.

Subjects and Methods

Forty-Three overweight (BMI- 28.6 ± 1.2 kg/m², mean age- 20.6 ± 1.5 years) and 39 normal weight (BMI - 21.8 ± 2.0 kg/m², mean age - 20.4 ± 1.4 years) male students from Baghdad University/ Medical College participated voluntarily in this study. The ages of all subjects ranged from 19 to 24 years. The study was conducted during the period from October 2010 till March 2011.

Students were selected randomly; all participants underwent a comprehensive physical examination. Participants were excluded from the study if they had any conduction diseases (bundle branch block, bradycardia), took any drugs that might cause QT prolongation, had any family history of sudden death or any personal history of hypertension, diabetes or syncope. QT interval in women is longer compared with men because of the effect of sex hormones on cardiac electrophysiology.[24] In order to evaluate the effect of overweight on cardiac repolarization, we only recruited men with the same age group into the study. Therefore, the data of this study is independent of sex and age.

All subjects were non-smokers. Blood pressures of all were within normal limits. Blood pressure was measured indirectly by auscultation (listening to sounds) described in 1902 by Russian physician N.S. Korotkoff, using a stethoscope and

sphygmomanometer (SK-MINIATUR 300B- Germany). Height and weight of the participants were measured just before the electrocardiogram (ECG) recording. Height was measured without shoes. Body mass index was calculated by dividing weight in kilograms by the square of the height in meters and BMI of 25 to 29.9 was defined as overweight and scores of 18.5 to 24.9 were accepted as normal.[1]

Standard 12-lead ECG was recorded [using BTL- cardio (UK) ECG machine] while the subjects resting in supine position. Paper speed of the ECG was 25 mm/sec and gain was 10 mm/mV. All the recordings were performed by the same investigator.

The onset of the Q wave was regarded as the starting point of the QT interval. The point where the T wave returned to the isoelectric TP segment was accepted as the end of the QT interval. QT interval was manually measured by calculating the average of sequential 3 QT distances from the precordial lead of V5. Corrected QT

(QTC) was calculated using the Bazett's formula of $QTC = QT/\sqrt{RR}$. [6]
Statistical analysis:

All calculations and analyses were performed using Statistical Package for the Social Sciences (SPSS version 11.5 for windows). Data was presented as mean $\pm$ Standard deviation (SD). The student t-test was used to compare variables of overweight group with that of the normal weight group. The level of statistical significance was defined as $P < 0.05$, which was obtained by comparing the calculated t-value to the tabulated t-value at 95% confidence interval. Simple linear regression was used and the correlation coefficient (r) was calculated.

Results

Table (1) showed that there were significant statistical differences in systolic blood pressure, diastolic blood pressure, Q-T interval duration and corrected Q-T interval duration between subjects in group1 with normal weight and subjects in group2 (overweight).

Table 1 Comparison of cardiac & ventricular repolarization parameters between group1 (normal weight) and group2 (overweight).

	Group1 (Normal) (n= 39) <u>Mean$\pm$SD</u>	Group2 (Overweight) (n= 43) <u>Mean$\pm$SD</u>	<i>P-value</i>
Systolic blood pressure	125 $\pm$ 14	132 $\pm$ 5	0.006*
Diastolic blood pressure	75 $\pm$ 5	77 $\pm$ 3	0.014*
Q-T(msec.)	311 $\pm$ 28	327 $\pm$ 25	0.008*
Q-Tc (msec.)	382 $\pm$ 23	396 $\pm$ 20	0.004*

*Significant ($P < 0.05$).

Figure (1) showed that there was a significant positive linear correlation between BMI and systolic blood pressure ($r=0.079$, $P=0.01$).

Figure (2) showed that there was a significant positive linear correlation

between BMI and diastolic blood pressure ($r=0.087$, $P=0.008$).

Figure (3) showed that there was a significant positive linear correlation between BMI and Q-T interval duration ($r=0.105$, $P=0.003$).

Figure (4) showed that there was a significant positive linear correlation between BMI and corrected Q-Tc interval duration ($r=0.142$, $P=0.001$).

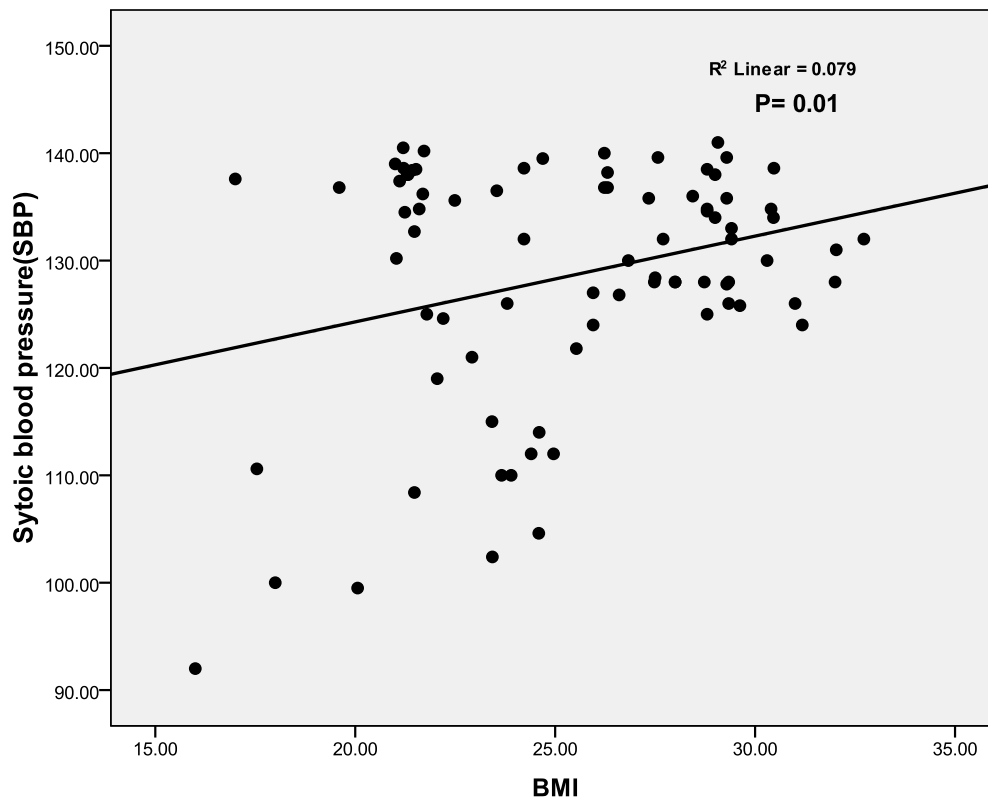


Figure 1 Correlation between BMI and Systolic blood pressure.

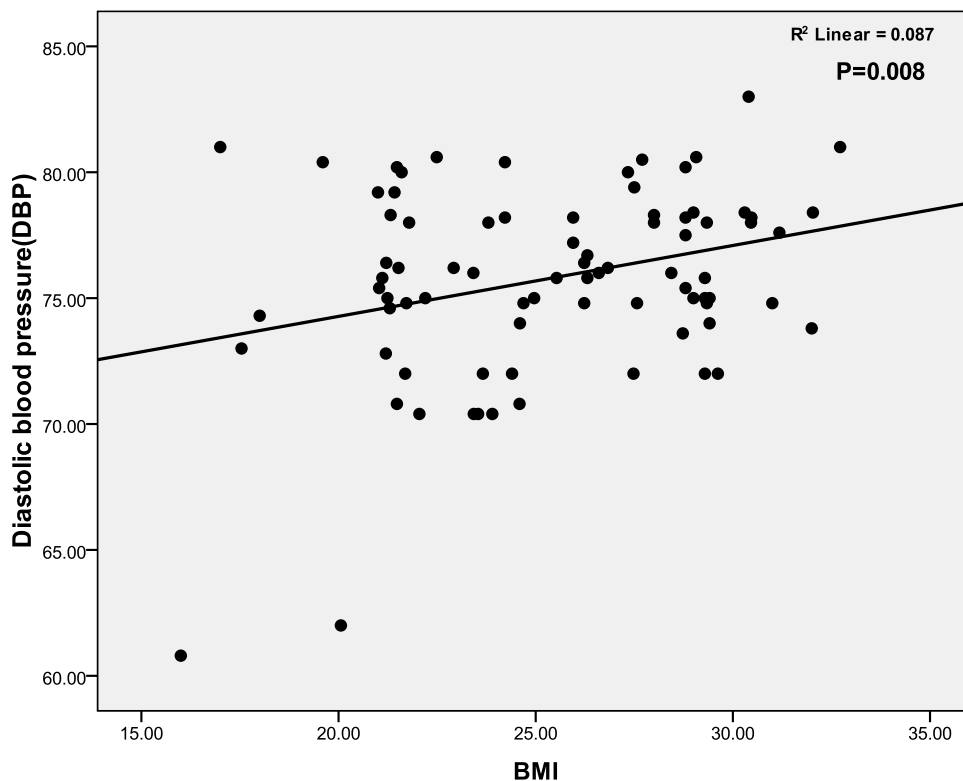


Figure 2 Correlation between BMI with Diastolic blood pressure.

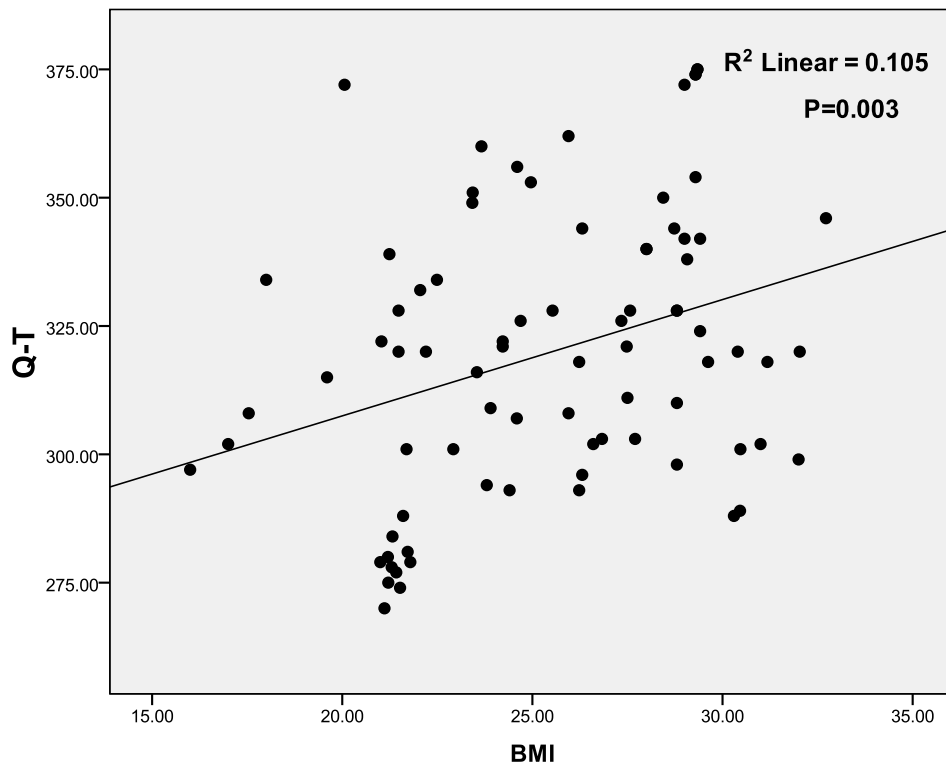


Figure 3 The correlation between BMI and Q-T interval duration.

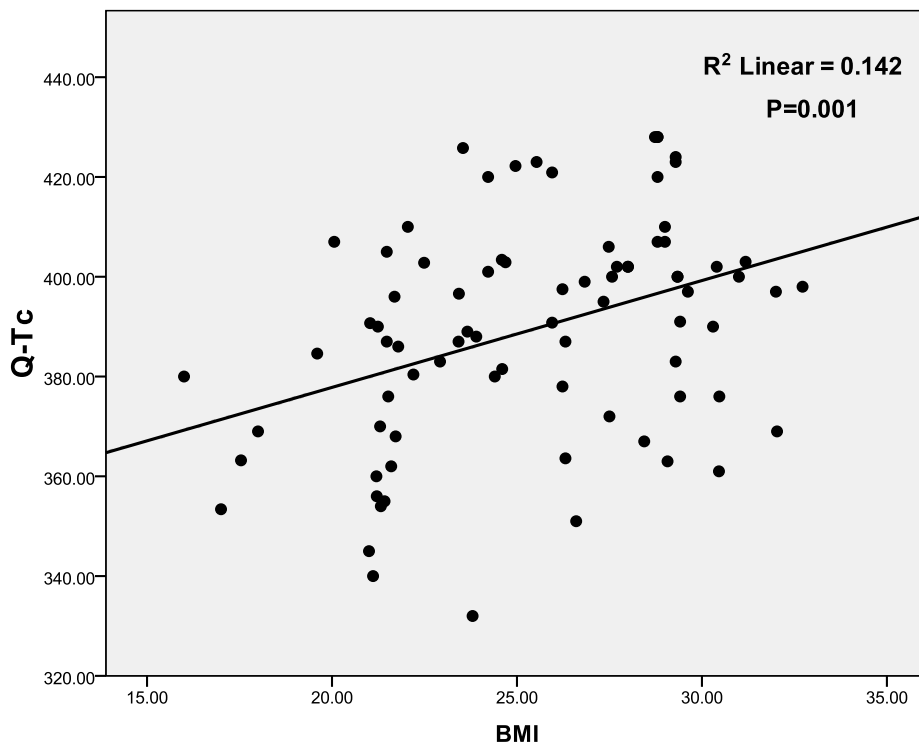


Figure 4 The correlation between BMI and corrected Q-Tc interval duration.

Discussion

In recent years, there has been increasing speculation over which measure of overweight and obesity is

best able to discriminate those individuals who are at increased cardiovascular risk. Body mass index (BMI) is used by the World Health

Organization to define severity of overweight and obesity across populations [7]

From the results of this study (table1), there were significant statistical differences in Systolic and diastolic blood pressure between subjects in group 1(normal weight) and group2(overweight), agreed with other studies[3]&[8]. The overweight category is associated with increased relative and population attributable risk for hypertension and cardiovascular sequelae. Interventions to reduce adiposity and avoid excess weight may have large effects on the development of risk factors and cardiovascular disease at an individual and population level[9].

Positive linear correlation was found between BMI and systolic and diastolic blood pressure of subjects involved in this study (figure 1&2), similar to the results of [10],[11], [12].

It has been suggested that initial sympathetic hyperactivity may lead to high blood pressure and progressive hyper-stimulation, followed by down-regulation, of beta-adrenergic receptors, with subsequent development of obesity because of the lesser beta-adrenoceptors that induces dissipation of calories. Overweight and obesity may be associated with hypertension through an increased sympathetic tone, increased fluid retention and insulin resistance[13].

The length of QT interval represents the time interval between the start of activation of the ventricle and the completion of its repolarization; a prolongation of this interval expresses delayed repolarization of the ventricular myocardium and is considered a precursor of malignant arrhythmias and sudden death[14].

The results of this study showed a positive linear correlation between BMI and QT interval duration

and corrected QTc (figure 3&4), similar results were reported by [3],[15],[16]&[20].

Selmaetal. [1] showed that QTc interval duration in men who are overweight were not significantly different from those of normal weight men. Nomura et al. [21] compared the ECG values of normal weight, overweight and obese coronary artery disease patients (average age 58 years) and no significant QT duration differences were observed between overweight and normal-weight coronary artery disease patients.

Several putative mechanisms were suggested as responsible for the effect of BMI on the duration of QT interval. Autonomic dysfunction or imbalance may be one of the factors. Peterson et al. [17] observed depressed autonomic outflow in heart in obese subjects. Furthermore, Rossi et al. [18] reported cardiac autonomic dysfunction and reduced vagal tone in obese subjects. Other mechanisms may include functional and structural changes of the heart [19]. Obesity causes significant abnormalities in cardiac morphology including left atrial enlargement, left ventricular geometric changes, and diastolic dysfunction. Obesity may lead to atrial and ventricular repolarization anomalies.[22] The QT interval is influenced by the autonomic tone: sympathetic stimulation unopposed by vagal activity might induce ventricular electrical instability, resulting in a risk of arrhythmia and sudden death as reported to occur in obese patients.[23]

Conclusion

The results of this study indicate that the problem of overweight in young men should not be ignored. In a younger age group, weight gain and a higher BMI may affect cardiac and ventricular repolarization parameters,

even if there are no obesity-related disorders, such as diabetes, hypertension, and coronary artery disease.[3]

References

- (1) Selma Arzu Vardar, Levent Öztürk, Armağan Altun, Nesrin Turan: Ventricular repolarization in overweight and normal weight healthy young men - Original Investigation: The Anatolian Journal of Cardiology (Anadolu Kardiyoloji Dergisi), Feb, 2008.
- (2) Oren A, Vos LE, Uiterwaal CS, Bots ML.: Cardiovascular risk factors and increased carotid intima-media thickness in healthy young adults: the Atherosclerosis Risk in Young Adults (ARYA) Study. Arch Intern Med 2003; 163: 1787-92.
- (3) Erol Arslan, Omer Yiğiner, İrfan Yavaşoğlu, Fatihozçelik: Effect of uncomplicated obesity on QT interval in young men. POLSKIE ARCHIWUM MEDYCYNY WEWNĘTRZNEJ., 2010; 210(6).
- (4) Fraley MA, Birchem JA, Senkottaiyan N, Alpert MA: Obesity and the electrocardiogram. Obes Rev. 2005 Nov; 6(4):275-81.
- (5) Pi-Sunyer FX.: Medical hazards of obesity. Ann Intern Med 1993; 119: 655-660.
- (6) Bazzet HC. :An analysis of the time-relations of electrocardiograms. Heart. 1920; 7: 353-370).
- (7) WHO expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004; 363:157-163.
- (8) Almas A, Jafar TH.: Adiposity and Blood Pressure in South Asian Children and Adolescents in Karachi. Am J Hypertens. 2011 Apr 21.
- (9) Wilson Peter W.F., Dagostino Ralph B., Sullivan Lisa, Parise Helen: Overweight and obesity as determinants of cardiovascular risk: The Framingham experience Archives of internal medicine, 2002, vol. 162, n°16, pp. 1867-1872.
- (10) Adediran Os., Jimoh Ak. & Musa Di: Relationship Between BMI And Blood Pressure In Rural Nigerian Dwellers. The Internet Journal of Nutrition and Wellness. 2009 Volume 7 Number 1
- (11) Katona E, Zrínyi M, Komonyi E, Lengyel S, Paragh G: Factors influencing adolescent blood pressure: the debrecen hypertension study. Kidney Blood Press Res. 2011; 34(3):188-95. Epub 2011 Apr 18.
- (12) Tesfaye F, Nawi NG, Van MH, Byass P.: Association between body mass index and blood pressure across three populations in Africa and Asia. J Hum Hypertens 2007 Jan; 21(1):28-37.
- (13) Verdecchia P, Trimarco B.: Obesity and hypertension, G Ital Cardiol (Rome). 2008 Apr; 9(4 Suppl 1):54S-59S.
- (14) Leotta G., Maule S., Rabbia F., Del Colle S.: Relationship between QT interval and cardiovascular risk factors in healthy young subjects. Journal of Human Hypertension (2005) 19, 623-627.
- (15) Seyfeli E, Duru M, Kuvandik G, Kaya H, Yalcin F.: Effect of weight loss on QTc dispersion in obese subjects. Anadolu Kardiyol Derg 2006; 6: 126-9.
- (16) Kaess BM, Jozwiak J, Mastej M, et al.: Association between anthropometric obesity measures and coronary artery disease: a cross-sectional survey of 16,657 subjects from 444 Polish cities. Heart. 2010; 96: 131-135.
- (17) Peterson HR, Rothschild M, Weinberg CR, Fell RD: Body fat and the activity of the autonomic

nervous system. N Engl J Med 1988; 318: 1077-83.

(18)Rossi M, Marti G, Ricordi L, Fornasari G, et al.: Cardiac autonomic dysfunction in obese subjects. ClinSci (Lond) 1989; 76: 567-72.

(19)Lauer MS, Anderson KM, Kannel WB, Levy,D. :The impact of obesity on left ventricular mass and geometry. The Framingham Heart Study.JAMA 1991; 266: 231-6.

(20) Braschi A, Abrignani MG, Francavilla VC, Francavilla G: Novel electrocardiographic parameters of altered repolarization in uncomplicated overweight and obesity.Obesity (Silver Spring).2011 Apr;19(4):875-81.

(21) Nomura A, Zareba W, Moss AJ.: Obesity does not influence electrocardiographic parameters in

coronary patients. Am J Cardiol 2000; 85: 106-8.

(22)Iacobellis G, Ribaudo MC, Leto G, et al.: Influence of excess fat on cardiac morphology and function: study in uncomplicated obesity. Obes Res.2002; 10: 767-773.

(23)Grazia Maria Corbi, Scipione Carbone, PatriziaZiccardi, Giovanni Giugliano: FFAs and QT Intervals in Obese Women with Visceral Adiposity: Effects of Sustained Weight Loss Over 1 Year.The Journal of Clinical Endocrinology & Metabolism,2002; Vol. 87, No. 5.2080-2083.

(24)Rodriguez I, Kilborn MJ, Liu XK, et al. Drug-induced QT prolongation inwomen during the menstrual cycle. JAMA.2001; 285: 1322-1326.