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RESEARCH ARTICLE
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ANALYTICAL CROSS-SECTIONAL STUDY TO DETERMINE WHETHER SIGNIFICANT CORRELATION IS PRESENT BETWEEN CORRECTED QT INTERVAL WITH BMI AND WAIST-HIP RATIO IN 1ST PROFESSIONAL MBBS STUDENTS IN MEDICAL TEACHING INSTITUTE

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ABSTRACT

Prolonged QT interval is associated with high incidence of coronary heart disease in adults. Our country has a significant prevalence of coronary heart disease, and now the prevalence of obesity is also increasing specially among the younger population. Obesity is also found to be associated with prolonged QT interval. This study was carried out to determine whether significant correlation is present between QTc (*corrected QT interval*) and waist-hip ratio and BMI in 1st professional MBBS students. This is a cross-sectional (observational), analytical study. BMI, waist & hip circumference and ECG are recorded by standard techniques. Waist hip ratio (WHR) is calculated. QTc is calculated using Bazett's formula. Pearson's correlation coefficient will be calculated for association between BMI and QTc as well as for association between WHR and QTc. This study shows that QTc interval in young adults is significantly positively correlated with BMI, WC, and WHR. Obesity is associated with increase in levels of leptin, free fatty acids and pro-inflammatory cytokines. The findings of this study will motivate the population towards a life of enhanced physical activity.

Keywords: Corrected QT Interval, BMI, Waist-hip Ratio, MBBS students

INTRODUCTION

The prevalence of obesity is increasing in India especially in the younger generation (42.01%).[1] the changing lifestyles of younger generations predispose them to obesity. Obesity has been linked with a number of cardiovascular co-morbidities like hypertension, heart failure and ischemic heart diseases.[2] Obesity is also associated with morphological changes in ECG like QT interval prolongation.[3] Prolonged QT interval in ECG is a risk factor for the development of ventricular tachyarrhythmia, syncope and sudden cardiac death.[4] Previous studies have found positive associations between prolonged QT intervals and obesity.[5] Most of the previous literature is concerned with studies on adult population.[5,6] There is paucity of studies done in the young subjects. The prevalence of cardiovascular risk factors has increased sharply in the younger age group in our population.[7] so, it is important to find out if obesity in young population is associated with QT interval prolongation, to create awareness and application of preventive measures.

Aim:

To determine whether significant correlation is present between corrected QT interval (QTc) and waist-hip ratio and BMI in 1st professional MBBS students.

Objectives:

1. To determine whether there is significant correlation between QTc and BMI and QTc and waist-hip ratio
2. To estimate corrected QT (QTc) interval by the Bazett's formula of the study population.
3. To estimate BMI and waist-hip ratio of the study population.

MATERIAL AND METHODS

Type of study: This is a cross-sectional (observational), analytical study.
The study population consisted of 1st year medical students.
Inclusion criteria for subjects: The study population will be medical students aged between 18 – 20 years of both genders who are willing to participate in the study.
Exclusion criteria: History of hypertension, endocrinal disorders, smoking, alcohol intake, medication affecting the QTc interval.
Sample size: With reference to the study by Sharma et al[6], the sample size was calculated with the help of correlation coefficient in the said study;

$$(Z^2/r^{2)}+1 = 2.576^2/0.2^2+1=166.89$$

Therefore, the target sample size was rounded off to 170.
After obtaining informed consent from the participants, the anthropometric measurements were recorded with the help of stadiometer and weighing machine. The body mass index (BMI) was calculated by the formula BMI = Weight (kg) / (Height in meter)^2. The Asian classification for BMI was used as suggested by Mishra et al.[8]
Normal BMI: 18.0-22.9 kg/m^2, Overweight: 23.0-24.9 kg/m^2, Obesity: >25 kg/m^2

Waist Hip ratio (WHR) was calculated as follows $\frac{\text{Waist circumference (cm)}}{\text{Hip circumference (cm)}}$

Waist circumference was measured in the standing position with a stretch resistant tape at a point midway between the highest point of iliac crest and lowest point of the costal margin in the mid-axillary line at the end of expiration when the subject was breathing quietly. Hip circumference was measured across the broadest part of the buttocks with the tape parallel to the floor.

As per the study done by Chamukuttan S (2003)[9], the following WHR is considered to be associated with low risk - men - < 0.88 and women - < 0.81.

The electrocardiogram was recorded with the help of a Phillips ECG machine (Model C3i). The participants were made to lie down comfortably on examination couch. Skin was thoroughly cleaned with spirit and cardiogel was applied. Limb and chest electrodes were placed and recording of 12 lead ECG was done in sequence with the paper speed of 25 mm/s and amplitude of 10 mm/mV. QT interval was measured from beginning of Q wave up to end of the T wave in the ECG lead II. A mean of 3 QT intervals was calculated. The QT interval was corrected for heart rate with the help of Bazett's formula (QTc = QT interval/square root of R-R interval)[10]. R – R interval was measured from ECG lead II. As per the study done by Goldenberg I et al (2006) [10], the Bazett corrected QTc values used for diagnosing QT prolongation in adult males and females are as follows: -
Males: - Normal <430 ms, borderline: 430–450 ms, and prolonged/abnormal: >450 ms
Females: - Normal <450 ms, borderline: 450–470 ms, and prolonged/abnormal: >470 ms

Data analysis: - Statistical analysis was done on SPSS 25th Version as per following objectives:
1. To find out the correlation between WHR & QTc interval
2. To find out the correlation between BMI & QTc interval

All the data is in the form of mean ± SD.
Pearson's correlation coefficient was calculated with 95% confidence interval.

RESULTS

A total of 168 students participated in the study, 88 were males and 80 were females.

Table 1: Baseline characteristics of the population

Table 1			
Characteristic	**Total population**	**Males**	**Females**
N	168	88	80
Age (years)	19.51± 0.56	19.5 ± 0.49	19.37 ± 0.5
BMI (kg/m^2)	22.09 ± 3.59	21.9 ± 2.52	22.2 ± 3.6
WHR	0.83 ± 0.06	0.85 ± 0.05	0.81 ± 0.06
WC (cm)	78.05 ± 8.01	80.49 ± 6.41	75.3 ± 8.98
QTc (seconds)	0.382 ± 0.056	0.375 ± 0.04	0.390 ± 0.04

Table 1 depicts the baseline characteristics of the population. The mean age of the total population was 19.51± 0.56 years. Mean BMI of the total population was 22.09 ± 3.59 kg/m^2. The female subjects had a slightly higher mean BMI (22.2 ± 3.6 kg/m^2) as compared to the males (21.9 ± 2.52 kg/m^2). The mean WHR of the total population was 0.83 ± 0.06, with males having a slightly higher WHR (0.85 ± 0.05) as compared to the females (0.81 ± 0.06). The mean WC of the whole population was 78.05 ± 8.01 cm, with males having a higher WC (80.49 ± 6.41 cm) as compared to females (75.3 ± 8.98 cm). The mean QTc of the total population was 0.382 ± 0.056 s, with males having less mean QTc (0.375 ± 0.04 s) as compared to that of the females (0.390 ± 0.04 s). Overall, only 9 (5.4%) subjects had QTc prolongation, 7 were males (QTc > 0.450 s) and 2 were females (QTc > 0.470 s).

The Pearson correlation analysis revealed positive correlation between BMI and QTc and WHR and QTc, as depicted in Figure 1 and table 2: -

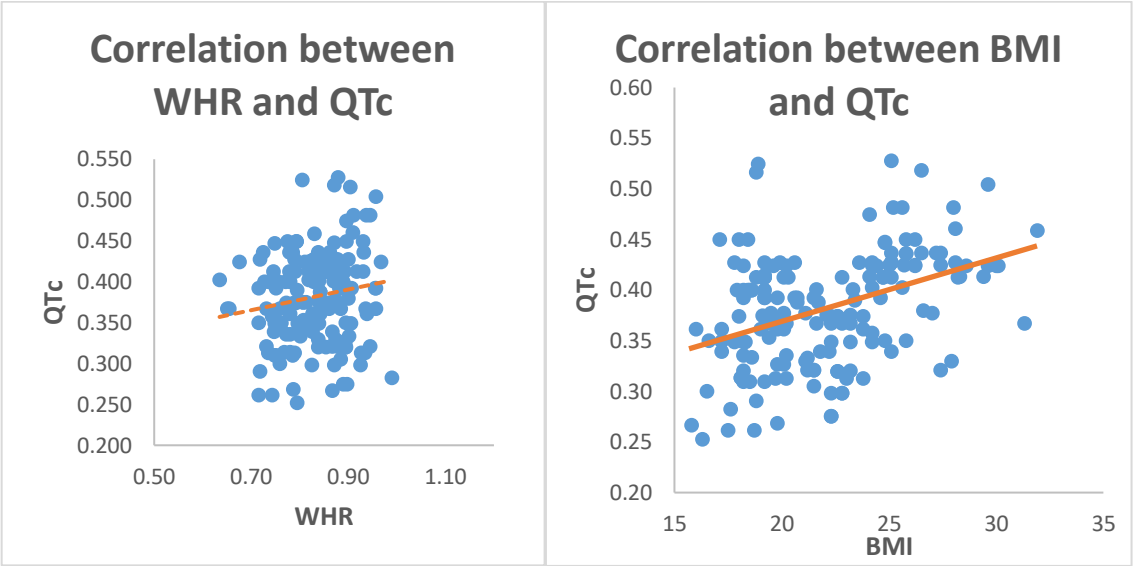

Figure 1: Correlation among study variables

Table 2: Correlation analysis between variables and QTc for whole population		
	r	**p**
BMI	0.40	<0.0001*
WHR	0.15	0.045*
WC	0.28	0.00028*
HC	0.24	0.002*

r- Pearson's correlation coefficient
p – Statistical significance
*- indicates statistical significance

The analysis reveals varying correlations between QTc and different anthropometric variables. Body Mass Index (BMI) and Waist Circumference (WC) exhibit statistically significant moderate positive correlations with QTc ($r = 0.40$, $p < .0001$ for BMI; $r = 0.28$, $p = 0.00028$ for WC), indicating that higher BMI and WC values are associated with longer QTc intervals. Waist-to-Hip Ratio (WHR) also shows a positive & significant correlation with QTc ($r = 0.15$, $p = 0.045$), although the strength of association is weaker as compared to that in case of BMI & WC. Hip Circumference (HC) displays a significantly positive correlation with QTc ($r= 0.24$, $p = 0.002$), although it is weaker as compared to BMI and WC.

As the QTc interval is different among males and females, we also analyzed the association of QTc with BMI, WHR and WC in males and females separately.

Table 3: Correlation between QTc and BMI, WHR, WC, HC for Male students

Correlation between QTc and BMI, WHR, WC, HC for Male students			
Variable	**r (Pearson's correlation coefficient)**	**p (statistical significance)**	**Remark**
BMI	0.38*	< 0.05	Statistically significant
WHR	0.12	0.51	Statistically not significant
WC	0.34*	< 0.05	Statistically significant

*- indicates statistical significance

The correlation analysis conducted in male subjects reveals varying associations between body measurements and QTc. Body Mass Index (BMI) displays a statistically significant positive

correlation, with a Pearson correlation coefficient of 0.38 and a p-value of < 0.05. In contrast, Waist-to-Hip Ratio (WHR) exhibits no significant correlation, indicated by its correlation coefficient of 0.12 and a p-value of 0.51. Conversely, Waist Circumference (WC) demonstrate highly significant positive correlation, with correlation coefficients of 0.34 and p-values lower than 0.05. Among these measurements, WC displays the strongest correlation with the QTc.

Table 4: Correlation between QTc and BMI, WHR, WC, HC for Female students

Correlation between QTc and BMI, WHR, WC, HC for Female students.			
Variable	**r (Pearson's correlation coefficient)**	**p (statistical significance)**	**Remark**
BMI	0.42*	<0.0001	Statistically significant
WHR	0.28*	0.0035	Statistically significant
WC	0.32*	< 0.05	Statistically significant

*- indicates statistical significance

The table presents the Pearson correlation coefficients and associated p-values for the relationship between QTc and various body measurements among a sample of female students. Body Mass Index (BMI) exhibits a strong positive correlation with QTc, with a correlation coefficient of 0.42 and a highly significant p-value of less than 0.0001. Waist Circumference (WC) also shows a notable positive correlation, with a coefficient of 0.32 and a highly significant p-value ($p< 0.05$). Waist-to-Hip Ratio (WHR) demonstrates a moderate positive correlation (coefficient = 0.28 with a p-value of 0.0035). These findings suggest that BMI and WC may be particularly relevant factors associated with QTc among female students, potentially indicating cardiovascular health implications worthy of further investigation.

DISCUSSION

This study shows that QTc interval in young adults is significantly positively correlated with BMI, WC, and WHR. Although prolonged QTc interval were present in only a minority of population (9.68% males & 7.2% females, 33.6% Total), the QTc interval does have a tendency to be prolonged as BMI, WC and WHR go on increasing.

Similar results were found by Kumar et al (2019)[11] who performed a case-control study on adult males (mean age 25 ± 4 y) comparing QTc interval in obese and normal weight (according to BMI) subjects. The QTc interval was significantly prolonged in the obese subjects. Similarly, Grandinetti A et al (2010)[12] conducted a large population based cross sectional study to observe the association of QTc with BMI and with waist circumference. They found highly significant association between BMI and QTc and between waist circumference and QTc.

Similar to our study, other authors have also found strong associations between abdominal obesity and prolongation of QTc. Sharma et al (2018)[6] compared the QTc interval in male subjects (mean age 40 ± 9 y) with normal BMI, but with different WHR. They found a strong positive correlation between BMI and WHR, but the association between WHR and QTc was stronger than that between BMI and QTc. This emphasizes the importance of abdominal obesity in our population. Ma Q et al (2019)[13] performed similar study with both males and females as subjects, although they analyzed the gender data separately. They did not find significant correlation between generalized obesity (BMI) and QTc but found significant correlation between waist circumference and QTc. This signifies the stronger association of abdominal obesity on the QTc interval prolongation.

The cause of altered ECG morphology in obese subjects is thought to be the result of alteration in the activities of Na^+, Ca^+ and K^+ channels, which leads to change in durations of depolarization and

repolarization. Obesity is associated with increase in levels of leptin, free fatty acids and pro-inflammatory cytokines. All these substances are considered to be playing a part in the altered gating and trafficking of ion channels in the cardiac myocyte membranes.[14] the abnormalities of depolarization and repolarization are also thought to be a result of cardiomyopathy of obesity and sympathovagal imbalance in obese subjects.

CONCLUSIONS

With the increasing prevalence of junk food and physical inactivity in our young adults, it is important to make them aware of cardiac ill effects of obesity. The findings of this study will motivate the population towards a life of enhanced physical activity.

FUTURE PLANS

The authors plan to recruit the overweight and obese population in exercise programs. The QTc interval observations will be repeated after few months to ascertain if regular exercise and consequent decrease in BMI has any effect on the QTc interval.

LIMITATIONS OF THE STUDY

Sample size is limited due to the study setting in a teaching institute.

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