



Gender based comparison of blood pressure and heart rate in adolescent population.

1. MBBS, DCN, MCPS, M.Phil, (Ph.D Scholar)
Assistant Professor Physiology
Baqai Medical University, Karachi.
2. MBBS, MCPS
Assistant Professor Community Health Sciences
Karachi Medical and Dental College, Karachi.
3. MBBS, M.Phil
Associate Professor
Jhalawan Medical College-Kuzdar
4. MBBS, M.Phil (Anatomy)
Associate Professor Anatomy
DDC, DUHS, Karachi.
5. MBBS, M.Phil
Assistant Professor Physiology
DMC, DUHS, Karachi.
6. MBBS, M.Phil
Professor Physiology
DMC, DUHS, Karachi.

Correspondence Address:

Dr. Saleemullah Abro
Department of Physiology
Baqai Medical University, Karachi.
saleemullahabro41@gmail.com

Article received on:

14/10/2020

Accepted for publication:

04/01/2021

Saleemullah Abro¹, Quratullain Saleem², Jahanzaib Lashari³, Soofia Nigar⁴, Ghazala Masood Farrukh⁵, Sikander Adil Mughal⁶

ABSTRACT... Objective: To evaluate the gender based comparison of blood pressure and heart rate in adolescent population. **Study Design:** Comparative Cross Sectional Study. **Setting:** Department of Physiology, Baqai Medical University. **Period:** 15 February to 15 August in 2017. **Material & Methods:** A total of 500 student of MBBS, BDS and DPT of Baqai medical university were enrolled in this study by non-probability, purposive sampling, after taking ethical approval. Blood pressure was measured by using stethoscope and mercury sphygmomanometer, which is applied to the arm. Heart rate is measured by palpating the radial artery. This collected data were analyzed by using SPSS version 22.0. This data of male and female adolescents were analyzed separately due to autonomic regulation. **Results:** It was observed that Gender based comparison of mean weight, mean body mass index (BMI), mean Systolic Blood Pressure, mean Diastolic Blood Pressure, and mean heart rate between males and females had statistically significant (p -value <0.05) differences. Among the categories of Diastolic Blood Pressure, only mean Normotensive blood pressure comparison in males and females showed statistically significant (p -value <0.05) difference, while Age, categories of systolic blood pressure (Normotensive, Prehypertension, Hypertension) and Diastolic blood pressure (Prehypertension, Hypertension) had showed statistically non-significant (p -value >0.05) gender difference in study participants. **Conclusion:** In our study results the mean BMI, mean Systolic Blood Pressure, mean Diastolic Blood Pressure, and mean heart rate had statistically significant (p -value <0.05) differences in gender.

Key words: Adolescent, Blood Pressure, Body Mass Index, Gender, Heart Rate.

Article Citation: Abro S, Saleem Q, Lashari J, Nigar S, Farrukh GM, Mughal SA. Gender based comparison of blood pressure and heart rate in adolescent population. Professional Med J 2021; 28(11):1539-1545.
<https://doi.org/10.29309/TPMJ/2021.28.11.6145>

INTRODUCTION

Hypertension (HTN) or high arterial blood pressure is considered as one of the major risk factor, which is associated with cardiovascular diseases (CVD).¹ Hypertension or high arterial blood pressure is a non-communicable disease, which leads to complications (micro vascular and macro vascular) in different organs of the human body.² High arterial blood pressure is often labeled as a silent killer, as it is asymptomatic condition until a clinical feature of complications (micro vascular and macro vascular) develops in individual. Hypertension is one of the leading causes of mortality globally and it is major concern in health care system nowadays³, as it is a precursor to many of the cardiovascular diseases (CVDs) like ischemic heart diseases

(IHD) or left ventricular hypertrophy (LVH) and other events of cardiovascular diseases.⁴

According to the World Health Organization (WHO), the global prevalence of high arterial blood pressure was nearly 40% and annually it is responsible for causing 7.5 million deaths.⁵ High arterial blood pressure can occur in any age group however, adults are mostly sufferers. In Pakistani adult population, prevalence of high arterial blood pressure is 28% estimated number, and it is continuously increasing in number since 1990. Prehypertension usually occurs in childhood or in adolescents, that ultimately leads to development of high arterial blood pressure or HTN in adults. This occurs most probably in adolescents due to sedentary life style or use of fast foods or junk

foods.^{3,6} In Indian subcontinent, the prevalence of prehypertension was 45% to 55% in young adult, which is still increasing in number.⁶ Heart rate (HR) is the speed of the heart beat or number of ventricular contractions (beats) per unit time (bpm). It varies with condition (physiological or pathological) of the body including the metabolic needs and oxygen demand. Resting heart rate is directly associated with cardiovascular diseases like high arterial blood pressure or hypertension, hyperglycemia, hyperlipidemia (increased cholesterol and increased triglycerides).^{7,8,9} It has been observed in many studies that there is relationship between elevated resting heart rate and elevated blood pressure or high arterial blood pressure in pediatric group, so it suggests that elevation in heart rate or heart beat is marker of cardiovascular diseases (CVD) in childhood.^{10,11,12} This relationship occurs due to cardiovascular risk factor that is Obesity or high body mass index (BMI)^{10,11}, and it affects the heart rate or heart beat by means of inflammatory process.¹³ Pulse pressure is another risk factor for development of vascular stiffness and it is associated with increase in resting heart rate. Pulse pressure is affected by blood pressure (BP) level and obesity or high body mass index.⁸ Gender based evaluation should be considered in analyzing the association or relationship between resting heart rate, pulse pressure. Variation in values of heart beat or heart rate observed in males as compared to females.¹⁴ According to Rosa et al, that higher level of pulse pressure was observed in male adolescents as compared to females.¹⁵ These observations were due to hormonal differences and local fat accumulation that affects the cardiovascular activity like blood pressure, heart rate and pulse pressure.⁸ The purpose of this study was to evaluate the Gender based comparison of Blood pressure and heart rate in adolescent population.

OPERATIONAL DEFINITION

Hypertension

It is defined as individual having systolic blood pressure (SBP) more than 140mm Hg and a diastolic blood pressure (DBP) more than 90mm Hg or taking antihypertensive drugs.¹⁶

Pre-hypertension

It is defined as slight raised level of systolic blood pressure (SBP) between 120-139mmHg and for diastolic blood pressure (DBP) between 80-89mmHg.¹⁷

Adolescents

It is a stage of transitional development of physical and psychological that occurs from puberty to age of maturity.¹⁸

MATERIAL & METHODS

This Comparative, cross sectional study with non-probability convenience sampling was conducted in Department of Physiology of Baqai medical university Karachi from 15th February 2017 to 15th August 2017. The rationale of this study was to prevent the development of hypertension in prehypertensive medical students. This observational study was approved by the Ethical review Committee of Baqai Medical University Karachi (BMU-EC/2016-04). All participants were briefed about research procedure and its importance, and all students gave their written consent. 500 adolescents 'medical students of MBBS, BDS, DPT with age ranges from 18-25 years of either sex (250 males and 250 females) were enrolled in this study, who were attending the classes or practical or tutorials in department of physiology. Students without comorbid were included in this study. The students were having chronic illnesses like CVDs, diabetes mellitus (DM), tuberculosis (TB), morbid obesity, and H/O of essential hypertension or taking antihypertensive drugs were excluded from study. Data were collected from adolescents 'medical students and gathered by pre-tested questionnaire. The body mass index (BMI) was done by using anthropometric measurement [weight (kg) and Height (m²)]. Height in centimeters (cm) and weight in kilograms were taken from enrolled students by using stadiometer (M306800-ADE).

BMI=weight in (Kg)/ (Height in meters)²

Included students were classified into four groups according to WHO criteria (Table-I).¹⁹

Classification	BMI VALUES (kg/m ²)
Underweight	< 18.5kg/m ² .
Normal	18.5-24.99kg/m ² .
Overweight	25-29.99kg/m ² .
Obese	>30kg/m ² .

Table-I. WHO criteria for BMI standard level.

Blood pressure (BP) or arterial pressure (systole and diastole) was measured by using mercury manometer with stethoscope. It was measured in resting condition after sitting on chair or stool for 5 to 10 minutes. Arterial pressure was assessed or recorded at same time of the day especially during lunch break time. Heart rate or pulse rate was measured by palpating the arterial pulse especially radial pulse on the wrist with wrist watch for one minute. These measurements were done by same person and same instruments during study.

Data Analysis

Data was entered and analyzed by SPSS (Statistical Package for Social Sciences), version 22 after verification. Categorical variables like age, gender, blood pressure and body mass index (BMI) were expressed as frequency and percentage. For generating tables and graphs Microsoft word and excel was used in computer system. Descriptive data is expressed or described as a mean and standard deviation (mean \pm SD). The $p < 0.05$ was considered as a statistically significant.

RESULTS

A total of 500 (250 male and 250 female) medical students of different classes of MBBS, BDS, DPT were enrolled in this study. They were divided into two groups according to Gender bases into male and female groups. Table-II shows the comparison of various study categorical parameters on the basis of gender and it was seen that a slightly higher percentage of males were overweight than females [78(31.2%) vs. 65(26.0%)] whereas a slightly higher percentage of females were obese than males [7(2.8%) vs. 2(0.8%)]. A majority of both males and females were normotensive for both systolic blood pressure (56.8% and 70.0% respectively) and diastolic blood pressure

[129(51.6%) and 152(60.8% respectively)]. Table-III (Figure-1) shows the anthropometric parameters of participants, the mean age comparison in males (20.47 ± 1.69) and females (20.22 ± 1.67) showed statistically non-significant ($p\text{-value} > 0.05$) difference, mean weight comparison in males (62.80 ± 10.38) and females (61.04 ± 11.05) showed statistically significant ($p\text{-value} < 0.05$) difference and mean BMI comparison in males (23.32 ± 3.62) and females (22.70 ± 3.72) showed statistically significant ($p\text{-value} < 0.05$) difference, while the mean height comparison in males (2.71 ± 0.30) and females (2.69 ± 0.29) showed statistically non-significant ($p\text{-value} > 0.05$) difference in this study. Among the categories of mean blood pressure (BP), It was seen in study participants that mean Systolic Blood Pressure (SBP) comparison in males (113.96 ± 11.96) and females (110.34 ± 11.09) showed statistically significant ($p\text{-value} < 0.05$) difference, and the mean Diastolic Blood Pressure (DBP) comparison in males (75.74 ± 11.51) and females (73.03 ± 10.77) showed statistically significant ($p\text{-value} < 0.05$) difference. It was seen in study participants that mean Heart Rate comparison in males (82.91 ± 8.16) and females (80.62 ± 9.46) showed statistically significant ($p\text{-value} < 0.004$) differences in this study. Among the categories of Systolic Blood Pressure (SBP), It was seen in study participants that mean Normotensive blood pressure (BP) comparison in males (105.60 ± 7.08) and females (104.40 ± 3.39) showed statistically non-significant ($p\text{-value} > 0.05$) difference, the mean Pre-hypertensive blood pressure comparison in males (123.15 ± 5.18) and females (122.14 ± 3.93) showed statistically non-significant ($p\text{-value} > 0.05$) difference and the mean hypertensive blood pressure comparison in males (140.91 ± 2.02) and females (140.00 ± 0.00) showed statistically non-significant ($p\text{-value} > 0.05$) difference, on gender bases.

Among the categories of Diastolic Blood Pressure (DBP), It was seen in study participants that mean Normotensive blood pressure comparison in males (67.64 ± 5.37) and females (66.27 ± 7.07) showed statistically significant ($p\text{-value} < 0.05$) difference, the mean Pre-hypertensive blood pressure comparison in males (81.29 ± 2.19)

and females (80.60 ± 1.63) showed statistically non-significant ($p\text{-value} > 0.05$) difference, and the mean hypertensive blood pressure comparison in males (94.14 ± 16.64) and females (92.83 ± 6 .) showed statistically non-significant ($p\text{-value} > 0.05$) differences on gender bases. (Table-IV).

Variable	Gender	
	Male (n=250)	Female (n=250)
	Frequency (%)	Frequency (%)
BMI		
Underweight	29 (11.6%)	31 (12.4%)
Normal Weight	141 (56.4%)	147 (58.8%)
Overweight	78 (31.2%)	65 (26.0%)
Obese	2 (0.8%)	7 (2.8%)
p-value	>0.05	
Systolic BP		
Normotensive	142 (56.8%)	175 (70.0%)
Prehypertensive	97 (38.8%)	70 (28.0%)
Hypertensive	11 (4.4%)	5 (2.0%)
p-value	<0.05	
Diastolic BP		
Normotensive	129 (51.6%)	152 (60.8%)
Prehypertensive	92 (36.8%)	75 (30.0%)
Hypertensive	29 (11.6%)	23 (9.2%)
p-value	>0.05	

Table-II. Gender wise Comparison of Parameters BMI & BP.
 $p < 0.05$ - significant and $p > 0.05$ - non-significance.

Parameters	Males (n=250) Mean ± S.D.	Females (n=250) Mean ± S.D.	p-Value
Age (Years)	20.47 ± 1.69	20.22 ± 1.67	0.06
Weight (kg)	62.80 ± 10.38	61.04 ± 11.05	0.041
Height (m)	2.71 ± 0.30	2.69 ± 0.29	0.066
BMI	23.32 ± 3.62	22.70 ± 3.72	0.037
SBP(mmHg)	113.96 ± 11.96	110.34 ± 11.09	0.000
DBP(mmHg)	75.74 ± 11.51	73.03 ± 10.77	0.005
Heart Rate	82.91 ± 8.16	80.62 ± 9.46	0.004

Table-III. Gender based comparison of mean BP (SBP& DBP) and Heart Rate values.
 $p < 0.05$ - significant and $p > 0.05$ - non-significance.

Categories of Parameter	Gender		p-Value
	Male (n=250) Mean ± S.D	Female (n=250) Mean ± S.D	
SBP			
Normotensive	105.60 ± 7.08	104.40 ± 3.39	0.31
Pre-hypertensive	123.15 ± 5.18	122.14 ± 3.93	0.757
Hypertensive	140.91 ± 2.02	140.00 ± 0.00	0.583
DBP			
Normotensive	67.64 ± 5.37	66.27 ± 7.07	0.006
Pre-hypertensive	81.29 ± 2.19	80.60 ± 1.63	0.25
Hypertensive	94.14 ± 16.64	92.83 ± 6	0.421

Table-IV. Gender based comparison of categories of mean SBP and mean DBP.
 $p < 0.05$ significant, $p > 0.05$ non-significant.

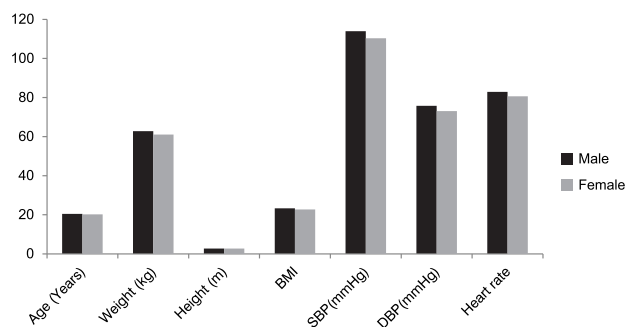


Figure-1. Gender based Comparison of mean Age, BMI, BP (SBP & DBP) and Heart Rate Values.

DISCUSSION

Our aim of this study was to evaluate the gender based comparison of blood pressure (systolic and diastolic) and heart rate in adolescents. This is comparative, cross sectional study, which includes 250 males and 250 female students of Baqai Medical University of Karachi. These students belongs to MBBS, BDS and DPT colleges of this university. We addressed the non-communicable diseases (overweight or obese and prehypertension or hypertension) in these included adolescents students. In our study, more female were underweight as compared to males [31(12.4%) vs 29(11.6%)], like these results, similar observation were seen by Alirezi Moafi et.al in his study.²⁰ This occurs due to physiological changes during pubertal growth spurt in female gender that leads to decrease in body mass index (BMI) in adolescents. The gender based comparison of blood pressure in adolescents were belongs to normotensive

group [SBP: 175(70.0) vs 142(56.8%)] and [DBP: 152(60.8%) vs 129(51.6%)] in females as compared to males (Table-I,II). Like these results were observed in Nigerian study.²¹ This supports our study results findings. Among the categories of mean blood pressure (BP), It was seen in study participants that the mean BMI comparison [male (23.32±3.62) vs females (22.70±3.72), mean Systolic Blood Pressure (SBP) comparison [males (113.96±11.96) and females (110.34±11.09)], the mean Diastolic Blood Pressure (DBP) comparison [males (75.74±11.51) and females (73.03±10.77)] and mean Heart Rate comparison [males (82.91±8.16) and females (80.62±9.46)] showed statistically significant (p-value<0.005) differences in this study participants. [Table-I,III] Study was done in Ghana that showed results similar to our results on gender bases comparison of systolic blood pressure, diastolic blood pressure and heart rate²² Similar results of mean values SBP and DBP were observed in males as compared to females.²³ these studies support our findings of study.

It was observed in adolescents' students of university that in categorical stages of systolic and diastolic blood pressure only normotensive category showed statistically significant(p-value<0.005) difference in gender based comparison. [Table-I,IV] Similar to our results were observed in readings of diastolic blood pressure (DBP) in gender based comparison between participants.²⁴ The blood pressure (systolic and diastolic) and heart rate are under control of central nervous activity via sympathetic activity that controls the heart and blood vessel, hormonal differences (estrogen, progesterone and testosterone) and local fat accumulation. It releases adiponectin, which stimulates sympathetic nervous system and inhabits parasympathetic nervous system (PNS).⁸

There should be modification in life style or promotion of physical exercises, dietary modification like use of fruits, use of vegetables, use of saturated fatty acids and decreasing the habits of using junk foods or fast foods or soft drinks for controlling the Non-communicable diseases like overweight or obesity and

prehypertension or hypertension (SBP and DBP) in adolescents.²⁵

As this study was done on students of Private Medical University, so that there were shortage of resources, Funds and also limited number of participants.

CONCLUSION

In our study results statistically significant (p-value<0.05) differences were observed in mean BMI, mean SBP, mean DBP and mean Heart rate in adolescent population.






Copyright© 04 Jan, 2021.

REFERENCES

1. S. O'Neill and L. O'Driscoll. "**Metabolic syndrome: A closer look at the growing epidemic and its associated pathologies.**" *Obesity Reviews*, 2015; 16(1): 1–12. DOI: 10.1111/obr.12229.
2. Whelton PK, Carey RM, Aronow, WS, Casey DE, Collins KJ, Himmelfarb CD, et al. **A guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: A report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines external icon.** *J Am Coll Cardiol.* 2018; 71(19):e127–e248. DOI: 10.1161/HYP.0000000000000066.
3. Aahmad L, Andrew J, Semotiuk, et al. **Anti-hypertensive plants of rural Pakistan: Current use and future potential.** *Journal of complementary medicine research* 2018; 7(2):138-153. DOI:10.5455/jcmr.20171228035946.
4. WHO **Raised blood pressure** [Internet]. Who. int. 2018 [cited 10 May 2018]. Available from: [http:// www.who. int/gho/ncd/risk_factors/blood_pressure_ prevalence text/en/](http://www.who.int/gho/ncd/risk_factors/blood_pressure_prevalence_text/en/).
5. Peltze K, Pengpid S, et al. **Prehypertension and psychosocial risk factors among university students in ASEAN countries.** *BMC Cardiovascular Disorders* 2017.17;230.
6. R. A. Fernandes, E. R. VazRonque, D. Venturini et al., "**Resting heart rate: Its correlations and potential for screening metabolic dysfunctions in adolescents.**" *BMC Pediatrics.* 2013; 13(1): 48. DOI: 10.1186/1471-2431-13-48.
7. D. G. Christofaro, J. Casonatto, L. C. Vanderlei, G. G. Cucato, and R. M. Dias. "**Relationship between resting heart rate, blood pressure and pulse pressure in adolescents.**" *Arquivos Brasileiros de Cardiologia,* 2017; 108: 405–410. doi: 10.5935/abc.20170050.

8. F. Freitas Júnior, P.A. Monteiro, L. S. Silveira et al. **Resting heart rate as a predictor of metabolic dysfunctions in obese children and adolescents.** BMC Pediatrics, 2012; 12:1471-2431. DOI: 10.1186/1471-2431-12-5.
9. Fernandes RA, Freitas Junior IF, Codogno JS, Christofaro DG, Monteiro HL, Roberto Lopes DM. **Resting heart rate is associated with blood pressure in male children and adolescents.** J Pediatr. 2011; 158(4):634-7. DOI: 10.1016/j.jpeds.2010.10.007.
10. Kwok SY, So HK, Choi KC, Lo AF, Li AM, Sung RY, et al. **Resting heart rate in children and adolescents: Association with blood pressure, exercise and obesity.** Arch Dis Child. 2013; 98(4):287-91. <http://dx.doi.org/10.1136/archdischild-2012-302794>.
11. Rabbia F, Grosso T, Cat Genova G, Conterno A, De Vito B, Mulatero P, et al. **Assessing resting heart rate in adolescents: Determinants and correlates.** J Hum Hypertens. 2002; 16(5):327-32. DOI: 10.1038/sj.jhh.1001398.
12. Kotsis V, Stabouli S, Papakatsika S, Rizos Z, Parati G. **Mechanisms of obesity induced hypertension.** Hypertens Res. 2010; 33(5):386-93. DOI: 10.1038/hr.2010.9.
13. Young FL, Leicht AS. **Short-term stability of resting heart rate variability: Influence of position and gender.** Appl Physiol Nutr Metab. 2011; 36(2):210-8. DOI: 10.1139/h10-103.
14. Rosa ML, Fonseca VM, Oigman G, Mesquita ET. **Arterial prehypertension and elevated pulse pressure in adolescents: Prevalence and associated factors.** Arq Bras Cardiol. 2006; 87(1):46-53. DOI: 10.1590/s0066-782x2006001400007.
15. Abro S, Saleem Q, Rizwan M, Aamir E, Soomro S, Ali M. **Correlation of body mass index with blood pressure: A gender based comparison in medical students.** Professional medical J 2019; 26(11):1958-1964. DOI: <https://doi.org/10.29309/TPMJ/2019.26.11.3656>.
16. Altaf B, Jaweed S, Behram F, Khan ZA, Naz S. **Association of pre-hypertension with blood groups in young population.** Professional medical J. 2019; 26(11):1820-1824. DOI: <https://doi.org/10.29309/TPMJ/2019.26.11.469>.
17. **Macmillan dictionary for students macmillan.** Pan Ltd. (1981), page 14, 456. Retrieved 2010-7-15.
18. **WHO. World health organization.** 2016 [online] available from http://www.who.int/news_room/fact_sheets/detail/obesity_and_overweight. Accessed on 30 marches 2019.
19. Alireze Moafil, Soheila Rahgozar, Majid Hgias, Elham Vahdatahar et al. **A study on body mass index, Blood pressure, and Red blood cell indices in new entering students of the University of Isfahan.** Int J Prev Med 2011; (4):280-285.
20. Salamtu Umar Aliyu, Jamilu Tijani Ahmed, Adetoyeje Y, Oyememi. **The relationship between body mass index and blood pressure among university students in Maiduguri Nigeria.** International Journal of recent Advances in Multidisciplinary Research.2014; 1(11): 091-96.
21. Monday Omoniyi Moses¹, Francis Osei¹, Ericjunior Appiah¹, Agnes Obour¹, Lady Gwendolineakwa et al. **Examining and comparing the health and performance indices of university undergraduate students according to year of study and gender.** Journal of exercise rehabilitation 2017; 13(4): 405-412. doi: 10.12965//jer.1735006.503.
22. Catrionasyme, Michialabraham, Owicz, Gabriel T, Leonard, Ph.D et al. **Sex differences in blood pressure and its relationship to body composition and metabolism in adolescence.** Archpediatradolesc med. 2009; 163(9):818-825. DOI: 10.1001/archpediatrics.2009.92.
23. Sairenchi T, Iso H, Irie F, Fukasawa N, Ota H et al. **Underweight as a predictor of diabetes in older adults.** A large cohort study. Diabetes Care. 2008; 31:583-584. doi: 10.4065/mcp.2009.0230.
24. Frederick Vuvor. **Correlation of body mass index and blood pressure of adults of 30–50 years of age in Ghana.** J health res rev. 2017; 4:115-21. DOI: 10.4103/jhrr.jhrr_93_16.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Saleemullah Abro	Conception of study, Manuscript writing.	
2	Quratullain Saleem	Analysis, Data collection.	
3	Jahanzaib Lashari	Literature review, Critical review.	
4	Soofia Nigar	Interpretation, Data analysis.	
5	Ghazala Masood Farrukh	Discussion writing.	
6	Sikander Adil Mughal	Critical review, Planning.	