ORIGINAL ARTICLE

# Prevalence of overweight obesity among M.B.B.S. students

**Aditya Chauhan[1], Sagar Modi[2]**

[1]Research Associate, Department of General Medicine, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Swami Ram Nagar, Dehradun 248016, Uttarakhand; [2]Assistant Professor, Department of General Medicine, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Swami Ram Nagar, Dehradun 248016, Uttarakhand

| Abstract | Introduction | Methodology | Results | Conclusion | References | Citation | Tables / Figures |
|---|---|---|---|---|---|---|---|

## Corresponding Author

Corresponding Author: Dr Sagar Modi, MD, DM, Department of General Medicine, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Swami Ram Nagar, Dehradun – 248106, Uttarakhand, India
E Mail ID: sagarmodi1980@gmail.com

## Citation

Chauhan A, Modi S, Prevalence of overweight obesity among M.B.B.S. students. Indian J Comm Health. 2019;31(3):301-307.

**Source of Funding:** Nil **Conflict of Interest:** None declared

## Article Cycle

**Received:** 26/08/2019; **Revision:** 05/09/2019; **Accepted:** 10/09/2019; **Published:** 30/09/2019



## Abstract

**Background**: Prevalence of overweight-obesity is rising in India. Medical Professionals are vulnerable to overweight-obesity because of the sedentary lifestyle which is frequently adopted due to massive work burden. **Aim & Objective**: To assess prevalence of overweight-obesity and associated factors among MBBS students in a medical institute in north-Indian state of Uttarakhand. **Settings and Design**: Descriptive cross-sectional study **Methods and Material**: This study was conducted among 310 M.B.B.S. students at Himalayan Institute of Medical Sciences, Uttarakhand, between March and May 2019. Socio-demographic details were recorded using a structured pro forma. A pre-validated IPAQ questionnaire was used for assessment of physical activity. Anthropometric and clinical parameters were measured using standard techniques. **Statistical analysis used**: Independent student's t test and Chi square test were used to compare the quantitative variables and categorical variables, respectively. Pearson's correlation test was used to study the correlation of BMI with clinical parameters. **Results**: Among 310 study subjects, 164 (52.9%) were overweight-obese. The prevalence of abdominal obesity was 30.3 percent. Subjects with overweight-obesity, in comparison to normal BMI group, had higher frequency of smoking, higher systolic blood pressure, higher mean arterial pressure, higher pulse pressure and engaged more in high (category 3) physical activity. **Conclusions**: There was 52.9% prevalence of overweight-obesity in study cohort. Overweight-obese subjects had higher blood pressure and frequency of smoking, both traditional cardiovascular risk factors. Interestingly, more overweight-obese subjects engaged in high physical activity.

## Keywords

Overweight; Obesity; M.B.B.S. Student

## Introduction

Overweight and obesity are defined by World Health Organization (WHO) as "abnormal or excessive fat accumulation that presents risks to health". (1) A significant rise in prevalence of obesity affecting both men and women is seen in the last three decades worldwide. (2) Similar trends have been observed in India. ICMR INDIAB phase I study carried out among adult population of states of Tamil Nadu, Maharashtra, Jharkhand, and Union Territory of

Chandigarh found prevalence of obesity between 11.8 to 31.3% and prevalence of abdominal obesity between 16.9 to 36.1 percent. (3) People from younger age groups have also been affected. About one-fifth of Indian children and adolescents are either overweight or obese. (4)

Obesity is a well-known risk factor for diabetes mellitus, hypertension, non-alcoholic fatty liver disease, gall stones and osteoarthritis. (5,6) Childhood obesity increases the future risk of type 2 diabetes and hypertension by 5.4 and 2.7 times, respectively. (7)

Medical profession is synonymous with long duty hours, erratic food timings and exposure to a host of stressful situations which put medical students at risk to develop lifestyle associated disorders including overweight and obesity. Studies from central and south India have shown 9.4% to 38 % prevalence of overweight-obesity among M.B.B.S. students. (8-14) However, dietary habits and patterns of physical activity differ across the country. A study from north India will enrich the existing data on problem of overweight-obesity in medical students.

## Aims & Objectives

To assess the prevalence of overweight-obesity among M.B.B.S. students from a medical college in north-Indian state of Uttarakhand

## Material & Methods

This study was conducted in Himalayan Institute of Medical Sciences, a medical college in the state of Uttarakhand, India between March 2019 and May 2019. The study subjects included M.B.B.S. students from all professional years. All M.B.B.S. students more than eighteen years of age were eligible for the study. The exclusion criteria were (i) pregnancy, (ii) students on glucocorticoids, antidepressants and antipsychotics and (iii) students suffering from chronic kidney disease, chronic heart failure, chronic liver disease and tuberculosis. The study protocol was approved by the institutional ethics committee and all subjects provided informed written consent.

A self-administered questionnaire was used to collect the socio-demographic details, family history of diabetes, family history of hypertension and relevant past medical history. A pre-validated short version International physical activity questionnaire (IPAQ) was used to assess the patterns of physical activity. For objective quantitative assessment of physical activity, the responses on the IPAQ were converted to METs-minutes per week. Subsequently, students were categorized into low, moderate and high physical activity groups based on the standard IPAQ criteria. (15,16) We also assessed the average time a student spends sitting every day, described as sitting hours.

We measured height, weight, waist circumference, blood pressure and oxygen saturation in all the students. Weight was measured in kilograms (kg) using an electronic weighing machine (Omron HN283 Weighing Scale) capable of recording to the nearest 0.1 kg. During measurement of weight, subjects were in single layered clothing and phones, wallets and shoes were removed. Height was measured in centimeters (cm) using a stadiometer (Is Indosurgicals Pvt. ltd.) and was recorded to the nearest 1cm. Body mass index (BMI) was calculated using the standard formula, in which "weight in kilograms is divided by square of height in meters (kg/m2)". The WHO Asia specific guidelines were used to classify students according to BMI (i) underweight (<18.5 kg/m2), (ii) normal weight (18.5-22.9 kg/m2), (iii) overweight (23-24.9 kg/m2), (iv) obese-grade 1 (25-29.9 kg/m2), and (v) obese-grade 2 (>30 kg/m2). (17)

WHO-STEP approach was used for measuring waist circumference which requires the inch tape to be placed at the midpoint between lowest palpable rib and highest point of iliac crest and the measurement is taken during end of expiration. (18) Abdominal obesity was defined as "waist circumference more than or equal to 90 cm in men and more than or equal to 80 cm in women". Waist circumference greater than these cut-offs has been associated with increased risk of cardiovascular disorders. (19)

Blood pressure (BP) was recorded using a digital sphygmomanometer (Omron Hem 8712 BP Monitor) after the subject was sitting quietly for five minutes. Mean of two BP recordings was taken as patient's blood pressure. If these two readings differed by more than 10 mm Hg, a third recording was taken and the mean of those values was finally recorded. (20) We measured oxygen saturation of blood (SpO2) using a pulse oximeter [Dr Trust (USA) Professional Series Pulse Oximeter].

**Statistical analysis:** The calculated sample size for current study was 295, assuming 25.9 % prevalence (11), 95% confidence interval and 5% precision. The data was analyzed using SPSS software version 20. Independent student's t test was used to compare

the quantitative variables between normal BMI and overweight-obese group. The categorical data was compared between two groups using Chi square test. Pearson's correlation test was used to study the correlation of BMI with blood pressure indices and oxygen saturation. The p-value of <0.05 was considered statistically significant.

## Results

Three hundred and fourteen subjects were initially screened. Four out of 314 subjects who were on antidepressants were excluded. Among 310 subjects, 46 (14.8%) were from MBBS - 1st professional, 114 (36.8%) from MBBS - 2nd professional, 76 (24.5%) from MBBS - final professional (part 1) and 74 (23.9%) from MBBS - final professional (part 2). The demographic and clinical parameters of the study subjects have been summarized in (Table 1).

**Prevalence of overweight-obesity:**

Study subjects were categorized in to five BMI categories using WHO Asia specific cut-offs (Table 2). Among 310 subjects, 67 (21.6%) were found to be overweight and 97 (31.3%) were obese. Ninety-four of 310 subjects (30.3%) were found to have abdominal obesity. Among 94 subjects with abdominal obesity, only 7 (7.5%) belonged to normal BMI category. Rest 92.5% subjects with abdominal obesity were also either overweight or obese.

**Patterns of physical activity among M.B.B.S. students:**

Amount of physical activity carried out by study subjects was quantitatively assessed using IPAQ questionnaire. Subjects were classified in to low, moderate and high activity groups. Out of 310 subjects, 30 (9.67%) were having low physical activity, 172 (55.4%) with moderate physical activity, and 108 (34.83%) with high physical activity. Students spent 8.4 ± 2.82 hours sitting every day. Average sitting hours were 10.16 hours, 8.42 hours, and 8.02 hours, respectively among low, moderate and high physical activity groups.

**Normal BMI vs. overweight – obesity** (Table 3):

Proportion of males was higher in overweight-obese group compared to normal weight group. Though the absolute number of students who smoked was not large, their frequency was higher in overweight-obese group. Systolic blood pressure was significantly higher among overweight-obese subjects compared to subjects with normal BMI (119.3 ± 12.22 vs. 114.5 ± 10.47 mm Hg, p-value = 0.000). Similarly, mean arterial pressure (91.2 ± 8.17 vs. 88.9 ± 7.46 mm Hg, p-value = 0.013) and pulse pressure (42.0 ± 10.82 vs. 38.3 ± 9.52 mm Hg, p-value = 0.002) were higher among overweight-obese subjects compared to those with normal BMI. Weekly physical activity measured in terms of METs-minutes per week was significantly higher in overweight-obese group (3034 ± 2147.43 vs. 2145.8 ± 2123.98, p-value = 0.000). More subjects from overweight-obese group were engaged in high physical activity compared to the normal weight subjects (43.9% vs. 23.8%). Average sitting hours in overweight-obese group were similar to that in normal BMI group (8.1+ 2.74 hours/day vs. 8.7+ 2.93 hours/day, p-value = 0.231).

**Abdominal obesity vs. non-obese** (Table 4):

Subjects with abdominal obesity had significantly higher systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse pressure compared to subjects with normal waist circumference. Weekly physical activity measured in terms of METs-minutes per week was significantly higher in subjects with abdominal obesity compared to non-obese subjects. They also engaged more in high physical activity compared to non-obese subjects. Average sitting hours were not significantly different between two groups.

**Correlation of BMI with clinical parameters:**

There was a statistically significant but weak positive correlation of BMI with systolic blood pressure (r = 0.234; p-value = 0.000), diastolic blood pressure (r = 0.144; p-value = 0.011), mean arterial pressure (r = 0.210; p-value = 0.000), pulse pressure (r = 0.157; p-value = 0.006), METs-minutes per week (r = 0.215; p-value = 0.000) and SpO2 (r = 0.113; p-value = 0.046).

## Discussion

The prevalence of overweight-obesity in India has doubled in last one decade according to the national family health surveys. (21) Overweight-obesity is slowly spreading its roots across all ages and sections of our society. The noble profession of Medicine demands absolute dedication and a lot of hard work from its professionals often at the cost of ignoring their own health. These professionals remain at risk of developing lifestyle related disorders including overweight-obesity.

The present study aimed to assess prevalence of overweight-obesity among M.B.B.S. students at a Medical College in Uttarakhand. We found overweight-obesity in 164 (52.9%) of 310 students.

This observation is significant and a reason for concern as more than half of the study population comprising of budding doctors is overweight or obese. Earlier studies from central and southern parts of India have shown prevalence of overweight-obese among medical students ranging from 9.4%-37.5%. (8-15) The possible reasons for higher prevalence of overweight-obesity in present study could be (i) difference in dietary habits, (ii) distinct patterns and opportunities to engage in physical activity, and (iii) different socio-demographic profile. One-third of the study subjects were found to have abdominal obesity similar to that observed by Gudegowda KS et al. (12) and by Sivapraksham P et al.(15)

We observed that overweight-obese subjects performed more physical activity compared to subjects with normal BMI. Similarly, more subjects with overweight–obesity engaged in high (category 3) physical activity as compared to normal weight subjects. This observation is at variance with the common belief that lean individuals engage in higher levels of physical activity in comparison to overweight-obese individuals. Sivaprakasham P et al. in their study (15) used IPAQ to monitor physical activity in medical students and observed that overweight-obese subjects engaged more in low (category 1) physical activity than in high (category 3) physical activity. We hypothesize that contrasting observations in present study could be due to heightened consciousness among overweight-obese students about self-image and ill-effects of weight gain as well as higher motivation to lose weight. However, different dietary habits between overweight-obese subjects and those with normal BMI may also explain this finding. Higher calorie intake may negate the beneficial effects of increased physical activity. The dietary patterns of subjects could not be assessed in present study. We measured level of physical activity among study subjects using IPAQ which does not provide long-term estimation of physical activity carried out by study subjects. This could also partly explain the paradox between BMI and level of physical activity observed in this study.

Males were more predisposed to develop obesity compared to females and this finding is consistent with previous studies. However, gender difference was not observed between subjects with and without abdominal obesity suggesting similar predisposition of males and females to develop abdominal obesity.

Overweight-obese subjects were found to have higher systolic blood pressure, mean arterial pressure and pulse pressure as compared to subjects with normal BMI. Similarly, subjects with abdominal obesity were observed to have higher systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse pressure as compared to subjects with normal waist circumference. This finding is in agreement with previous studies (10,15) and adds further evidence to the association between overweight-obesity and hypertension. However, rise in blood pressure at such a young age in association with overweight-obesity raises concerns about increased future risk of development of cardiovascular disorders. Higher frequency of smokers in overweight-obese group could increase this risk further.

In present study, we found weak positive correlation between oxygen saturation and BMI. This finding is in contrast to the negative correlation observed between these two parameters by Vidyapeeth S et al.14. Higher physical activity in overweight-obese group as seen in present study might explain this observation.

## Conclusion

The present study from the state of Uttarakhand shows high prevalence of overweight-obesity among MBBS students. Students who are overweight-obese have higher blood pressure as well as higher frequency of smoking as compared to those with normal BMI. Both these observations put together make overweight-obese students more susceptible to future development of cardiovascular disorders. On a positive side, the overweight-obese individuals in our study were doing higher physical activity in an attempt to reduce their weight which reflects heightened awareness and willingness to take corrective steps on their part.

## Recommendation

Rising prevalence of overweight-obesity in subjects with younger age groups and its association with cardiovascular risk factors is an important public health concern. Regular screening for overweight-obesity starting at school level itself, counseling and motivation for healthy eating habits, daily physical activity and reduction of sitting hours may help to reduce the burden of this problem.

## Limitation of the study

This study has some limitations. Comprehensive evaluation of dietary habits of study subjects and assessment of metabolic parameters such as blood glucose, glycosylated hemoglobin and lipids could have provided further insight in to the problem of overweight-obesity among young M.B.B.S. students. This opens scope for further studies on this particular population.

## Relevance of the study

This is the first study to assess prevalence of overweight-obesity among medical students from the north Indian state of Uttarakhand and adds to the existing information derived from studies from central and south India.

## Authors Contribution

Both the authors have contributed in planning of the study, data analysis and writing of the manuscript. AC: carried out the study related measurements and data collection. SM: supervised the study.

## Acknowledgement

We would take this opportunity to thank all the study subjects for their participation and cooperation. We acknowledge the support provided by the Research committee of Himalayan Institute of Medical sciences. We are grateful to Mr. Shubham Pandey, Department of Biostatistics, Himalayan Institute of Medical sciences for help in statistical analysis.

## References

1. World Health Organisation. Obesity and overweight .WHO 2018. Available from: http://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight.
2. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, Mullany EC, Biryukov S, Abbafati C, Abera SF, Abraham JP, Abu-Rmeileh NM, Achoki T, AlBuhairan FS, Alemu ZA, Alfonso R, Ali MK, Ali R, Guzman NA, Ammar W, Anwari P, Banerjee A, Barquera S, Basu S, Bennett DA, Bhutta Z, Blore J, Cabral N, Nonato IC, Chang JC, Chowdhury R, Courville KJ, Criqui MH, Cundiff DK, Dabhadkar KC, Dandona L, Davis A, Dayama A, Dharmaratne SD, Ding EL, Durrani AM, Esteghamati A, Farzadfar F, Fay DF, Feigin VL, Flaxman A, Forouzanfar MH, Goto A, Green MA, Gupta R, Hafezi-Nejad N, Hankey GJ, Harewood HC, Havmoeller R, Hay S, Hernandez L, Husseini A, Idrisov BT, Ikeda N, Islami F, Jahangir E, Jassal SK, Jee SH, Jeffreys M, Jonas JB, Kabagambe EK, Khalifa SE, Kengne AP, Khader YS, Khang YH, Kim D, Kimokoti RW, Kinge JM, Kokubo Y, Kosen S, Kwan G, Lai T, Leinsalu M, Li Y, Liang X, Liu S, Logroscino G, Lotufo PA, Lu Y, Ma J, Mainoo NK, Mensah GA, Merriman TR, Mokdad AH, Moschandreas J, Naghavi M, Naheed A, Nand D, Narayan KM, Nelson EL, Neuhouser ML, Nisar MI, Ohkubo T, Oti SO, Pedroza A, Prabhakaran D, Roy N, Sampson U, Seo H, Sepanlou SG, Shibuya K, Shiri R, Shiue I, Singh GM, Singh JA, Skirbekk V, Stapelberg NJ, Sturua L, Sykes BL, Tobias M, Tran BX, Trasande L, Toyoshima H, van de Vijver S, Vasankari TJ, Veerman JL, Velasquez-Melendez G, Vlassov VV, Vollset SE, Vos T, Wang C, Wang X, Weiderpass E, Werdecker A, Wright JL, Yang YC, Yatsuya H, Yoon J, Yoon SJ, Zhao Y, Zhou M, Zhu S, Lopez AD, Murray CJ, Gakidou E. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014 Aug 30;384(9945):766-81. doi: 10.1016/S0140-6736(14)60460-8. Epub 2014 May 29. PubMed PMID: 24880830; PubMed Central PMCID: PMC4624264.[PubMed].
3. Pradeepa R, Anjana RM, Joshi SR, Bhansali A, Deepa M, Joshi PP, et al. Prevalence of generalized & abdominal obesity in urban & rural India- the ICMR - INDIAB Study (Phase-I) [ICMR- INDIAB- 3]. Indian J Med Res. 2015;142(2):139-50.
4. Ranjani H, Mehreen TS, Pradeepa R, Anjana RM, Garg R, Anand K, Mohan V. Epidemiology of childhood overweight & obesity in India: A systematic review. Indian J Med Res. 2016 Feb;143(2):160-74. doi: 10.4103/0971-5916.180203. Review. PubMed PMID: 27121514; PubMed Central PMCID: PMC4859125.[PubMed].
5. Abdelaal M, le Roux CW, Docherty NG. Morbidity and mortality associated with obesity. Ann Transl Med. 2017 Apr;5(7):161. doi: 10.21037/atm.2017.03.107. Review. PubMed PMID: 28480197; PubMed Central PMCID: PMC5401682.[PubMed].
6. Haslam DW, James WP. Obesity. Lancet. 2005 Oct 1;366(9492):1197-209. doi: 10.1016/S0140-6736(05)67483-1. Review. PubMed PMID: 16198769.[PubMed].
7. Aronow WS. Association of obesity with hypertension. Ann Transl Med. 2017 Sep;5(17):350. doi: 10.21037/atm.2017.06.69. PubMed PMID: 28936444; PubMed Central PMCID: PMC5599277.[PubMed].
8. Jayaraj, Nair PP, Napolean R, Stephen J, Nishanth K, Suresh D. Prevalence of Overweight and Obesity Among Students of a Medical College in South India: A Pilot Study. Indian Journal of Clinical Practice. 2014;25(4):333-37.
9. Kamath S, Souza J D. Prevalence of obesity among the medical students: a cross sectional study in a south Indian medical college. Al Ameen J Med Sc i .2013;6(1):93-95.
10. Singru S, Kshirsagar M, Pathan Y, Fernandez K. Study regarding overweight/obesity among medical students of a teaching hospital in Pune, India. Med J DY Patil Univ. 2014;7(3):279-83.
11. Tiwari R, Jain V, Singh Rajput A, Bhagwat AK, Goyal M, Tiwari S. A study to assess prevalence of obesity among medical students of G.R. medical college, Gwalior, M. P., India. Int J Res Med Sci.2014;2(4):1412–16.
12. Gudegowda KS, Vengatesan S, Sobagiah RT. Prevalence of overweight and obesity among medical college students, Bengaluru. Int J Community Med Public health. 2018;5(5):1881-86.
13. Lakshmi Y, Vasundara Devi B. A Study of Body Mass Index among Medical Students in a Tertiary Care Teaching Hospital. IOSR Journal of Dental and Medical Sciences. 2015;14(3):14–17.

14. Vidyapeeth S, Purohit G. Cardiovascular Risk Factors: Emergency Alarm for Today?. Kathmandu University Medical Journal . 2015;52(4):341-45.
15. Selvaraj K, Sivaprakasam P. A Study on the Prevalence of Overweight and Obesity among Medical Students of Kanchipuram District. National Journal of Research in Community Medicine. 2013;2(2):79-148.
16. Forde C. Scoring the International Physical Activity Questionnaire (IPAQ). Available from: www.ipaq.ki.se.
17. World Health Organization, International Association for the Study of Obesity, International Obesity Task Force. The Asia-Pacific Perspective: Redefining Obesity and Its Treatment. Sydney, Health Communications, 2000, p. 15–21.
18. World Health Organisation . Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation. 35 page . Available from: www.who.int.
19. Hruby A, Hu FB. The Epidemiology of Obesity: A Big Picture. Pharmacoeconomics. 2015 Jul;33(7):673-89. doi: 10.1007/s40273-014-0243-x. Review. PubMed PMID: 25471927; PubMed Central PMCID: PMC4859313.[PubMed].
20. Ogedegbe G, Pickering T. Principles and techniques of blood pressure measurement. Cardiol Clin. 2010 Nov;28(4):571-86. doi: 10.1016/j.ccl.2010.07.006. Review. PubMed PMID: 20937442; PubMed Central PMCID: PMC3639494.[PubMed].
21. SCIENCES IIFP. National family health survey -4 India ,Ministry of health and family welfare . Available from: http://www.rchiips.org/nfhs http://www.iipsindia.org

## Tables

### TABLE 1 DEMOGRAPHIC AND CLINICAL INFORMATION OF THE STUDY PARTICIPANTS (N=310)

| Parameters | Results |
|---|---|
| Age (years) | 20.9 ± 1.31 |
| Gender (male:female) | 138 : 172 |
| Family history of diabetes mellitus | 113 (36.45%) |
| Family history of hypertension | 110 (35.48%) |
| Smoking (daily) | 12 (3.8%) |
| Height (cm) | 160 ± 9.3 |
| Weight (kg) | 65.2 ± 13.28 |
| BMI (kg/$m^2$) | 23.8 ± 3.86 |
| Waist circumference (cm) | 80.7 ± 10.82 |
| Systolic blood pressure (mm Hg) | 117.0 ± 11.80 |
| Diastolic blood pressure (mm Hg) | 76.7 ± 7.85 |
| Pulse pressure (mm Hg) | 40.3 ± 10.38 |
| Mean arterial pressure (mm Hg) | 90.1 ± 7.97 |
| Pulse rate (beats per minute) | 76.6 ± 10.68 |
| $SpO_2$ (percent) | 98.3 ± 0.77 |
| METs-minutes per week | 2612.6 ± 2123.98 |
| Sitting hours (hours per day) | 8.4 ± 2.82 |
| Continuous data is presented as mean ± standard deviation, gender as proportion and categorical data as frequencies (percentage). | |

### TABLE 2 DISTRIBUTION OF STUDY SUBJECTS ACCORDING TO BMI (KG/M2)

| BMI category | Number (percentage) |
|---|---|
| Underweight (<18.5 kg/$m^2$) | 12 (3.9%) |
| Normal (18.5-22.9 kg/$m^2$) | 134 (43.2%) |
| Overweight (23.0-24.9 kg/$m^2$) | 67 (21.6%) |
| Obese-grade 1 (25.0-29.9 kg/$m^2$) | 80 (25.8%) |
| Obese-grade 2 (>29.9 kg/$m^2$) | 17 (5.5%) |

### TABLE 3 COMPARISON OF STUDY PARAMETERS BETWEEN NORMAL BMI AND OVERWEIGHT-OBESE

| Parameters | Normal weight (n = 134) | Overweight-obesity (n = 164) | p-value |
|---|---|---|---|
| Age (years) | 20.9 ± 1.27 | 21 ± 1.34 | .278 |
| Gender (male : female) | 46 : 88 | 85 : 79 | .002 |
| Family history of hypertension | 44 (32.8%) | 66 (40.2%) | .187 |
| Family history of diabetes | 46 (34.3%) | 58 (35.3%) | .852 |
| Smoking (daily) | 2 (1.4%) | 10 (6.0%) | .046 |
| Systolic blood pressure (mm Hg) | 114.5 ± 10.47 | 119.3 ± 12.22 | .000 |

| | | | |
|---|---|---|---|
| Diastolic blood pressure (mm Hg) | 76.2 ± 7.68 | 77.2 ± 8.04 | .255 |
| Mean arterial pressure (mm Hg) | 88.9 ± 7.46 | 91.2 ± 8.17 | .013 |
| Pulse pressure (mm Hg) | 38.3 ± 9.52 | 42.0 ± 10.82 | .002 |
| Pulse (beats per minute) | 77.3 ± 10.74 | 75.8 ± 10.71 | .205 |
| SpO2 (%) | 98.3 ± 0.85 | 98.4 ± 0.68 | .216 |
| METs-minutes per week | 2145.8 ± 2123.98 | 3034 ± 2147.43 | .000 |
| Physical activity group | | | |
| Low | 20 (14.9%) | 8 (4.8%) | .000 |
| Moderate | 82 (61.1%) | 84 (51.2%) | |
| High | 32 (23.8%) | 72 (43.9%) | |
| Sitting hours (hours per day) | 8.1± 2.74 | 8.7± 2.93 | .231 |

*Continuous data is presented as mean ± standard deviation, gender as proportion and categorical data as frequencies (percentage).*

**TABLE 4 COMPARISON OF STUDY PARAMETERS BETWEEN SUBJECTS WITH ABDOMINAL OBESITY AND THOSE WITH NORMAL WAIST CIRCUMFERENCE**

| Parameters | Normal waist circumference (n = 204) | Abdominal Obesity (n = 94) | p-value |
|---|---|---|---|
| Age (years) | 20.8 ± 1.36 | 21.5 ± 1.18 | .458 |
| Gender (male : female) | 89:115 | 42:52 | .865 |
| Family history of hypertension | 68 (33.3%) | 42 (44.6%) | .059 |
| Family history of diabetes | 66 (32.3%) | 38 (40.4%) | .174 |
| Smoking (daily) | 2.9% (6) | 6.6% (6) | .163 |
| Systolic blood pressure (mm Hg) | 115.4 ± 11.13 | 120.8 ± 12.10 | .000 |
| Diastolic blood pressure (mm Hg) | 75.9 ± 7.78 | 78.6 ± 7.8 | .005 |
| Mean arterial pressure (mm Hg) | 89.0 ± 7.58 | 92.7 ± 8.14 | .000 |
| Pulse pressure (mm Hg) | 39.5 ± 10.42 | 42.14 ± 10.23 | .046 |
| Pulse (beats per minute) | 76.1 ± 10.37 | 77.2 ± 10.86 | .442 |
| $SpO_2$ (%) | 98.3 ± 0.78 | 98.4 ± 0.72 | .380 |
| METs-minutes per week | 2444.1± 2207.38 | 3048.9 ± 2066.99 | .026 |
| Physical activity group | | | |
| Low | 22 (10.7%) | 6 (6.3%) | .012 |
| Moderate | 122 (59.8%) | 24 (25.5%) | |
| High | 60 (29.4%) | 44 (46.8%) | |
| Sitting hours (hours per day) | 8.3± 2.83 | 8.6± 2.87 | .211 |

*Continuous data is presented as mean ± standard deviation, gender as proportion and categorical data as frequencies (percentage).*