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Association of Lean Body Mass and Fat Mass Index with Pulse Pressure Among Young Adults: A Cross Sectional Study

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Abstract
Hypertension is the leading cause of cardiovascular disease (CVD), High Body Mass Index (BMI) is known to be associated with elevated blood pressure (BP). Using BMI to measure weight might not fully capture fat distribution. Recent doubts about BMI's accuracy in indicating obesity raise concerns. It is possible that lean body mass index(LBMI) gained during life course may have an impact on BP levels in adulthood, characteristic changes of blood pressure with age lead to increases in pulse pressure, a new, potentially independent risk factor of CVD. The study could help to identify whether the association of LBMI and fat mass index(FMI) with pulse pressure(PP) and any difference in relation between male and female can provide valuable insights into the long-term cardiovascular implications of body composition changes. To determine the association of lean body mass index and fat mass index with pulse pressure levels among young adults and to study any difference exist between males and females in Datia region. Study conducted at the Department of Physiology, GMC Datia (M.P.), includes 100 participants both male & female. Parameters of body composition, blood pressure was collected using calibrated instruments. Correlation was calculated by using Pearson formula and Microsoft excel data analyzer version 10. The findings reveal a positive correlation of Lean body mass index, fat mass index, with pulse pressure levels. Mean with low FMI and high LBMI were mostly men whereas persons with high FMI and low LBMI were mostly women. LBMI and FMI both shows a positive correlation with pulse pressure with LBMI more in males and FMI more in females. To maintain cardiovascular health, it's crucial to reduce overall obesity rather than solely focusing on increasing muscle mass. Staying active and adopting a healthy lifestyle are key factors for a thriving life.

INTRODUCTION

Hypertension is the leading contributor to the global burden of cardiovascular disease (CVD) and premature mortality[1]. Due to this high mortality, primordial prevention has been suggested for the attainment of health before the development of risk factors at the population level[2,3]. High body Mass Index (BMI) is known to be associated with elevated blood pressure (BP)[4]. Obesity, which is usually determined by BMI, is one the principal risk factors for hypertension[5,6] and the prevalence of hypertension increases with rising BMI[7,8]. However, BMI, as the most frequent anthropometric measure used, does not reflect body fat distribution and there has recently been some doubt concerning it as a convenient indicator of high body weight and obesity. Similarly, there are concerns about its capability to predict the risk of hypertension and CVD[9,10]. Few studies have deciphered whether lean body mass (LBM) or fat mass (FM) is predominantly responsible for the body mass index (BMI)-hypertension association[11]. BMI may not accurately differentiate between fat and muscle in a person's body. Genetic factors related to fat mass can influence blood pressure throughout life, but the role of fat-free mass is not clear. Even though genetic variation in fat-free mass may not trigger elevated BP, it is possible that fat-free mass gained during life course may have an impact on BP levels in adulthood[12]. The characteristic changes of systolic and diastolic blood pressure with age lead to increases in pulse pressure (systolic minus diastolic), which has emerged as a new, potentially independent risk factor. Furthermore, compelling evidence has emerged that PP is a strong indicator of cardiovascular risk even among normotensive individuals[13,14]. The study could help to identify whether gaining fat-free mass during the life course is associated with alterations in pulse pressure, which is relevant for assessing cardiovascular risk. It may guide the development of targeted lifestyle and intervention strategies. In summary, conducting a study on the association of lean body mass index and fat mass index with pulse pressure can provide valuable insights into the long-term cardiovascular implications of body composition changes. This knowledge can be applied to develop targeted interventions, personalized health recommendations and potentially influence public health strategies to reduce cardiovascular risks.

MATERIALS AND METHODS

100 young adults of 18-25 years of both genders were chosen for this study. Informed written consent was taken from all participants. In all the experimental settings, the assessment was performed in a dedicated room, with an optimal room temperature and respecting the privacy. All subjects were refrain from influencing their BP with exercise, alcohol, medicine or coffee during the 24 h period before conducting the experiment. Blood pressure was measured with automated sphygmomanometer according to recommendations from international guidelines[15]. In all participants, blood pressure measurements were obtained after resting for 5 min in a seated position, with 30s intervals between cuff inflations. An average of three measurements were used. Care was taken to select the cuff size according to the participant's arm circumference. Pulse pressure (PP) was calculated using the standard equation based on the difference between systolic blood pressure (SBP) and diastolic blood pressure (DBP). Height was measured using a standard Stadiometer with the subjects standing in erect posture. The readings was taken to the nearest 0.1 cm. Body composition parameters were measured using a calibrated Karada scan Omron-HBF-510. Assessment of lean body mass index (LBMI) was done by using Boer's formula divided by height in meter square and fat mass index (FMI) by converting fat percent to fat mass and dividing it by height in meter square for males and females individually.

RESULTS AND DISCUSSIONS

The mean of anthropometric parameters are shown in the Table I displays mean FMI is more in females and LBMI is more in males. Age, BMI and pulse pressure does not differ with significant value with respect to gender. Height, weight, LBMI, FMI, Systolic and diastolic BP are significantly different in both groups. Mean with low FMI and high LBMI were men whereas high FMI and low LBMI were mostly women. The relationship of fat mass index and lean body mass index with blood pressure (systolic and diastolic) and pulse pressure is shown in Table II for males and females individually. There is positive correlation between LBMI, FMI with PP in females. Males show positive correlation of FMI with SBP, PP, DBP and LBMI with PP, SBP but negative correlation with DBP. Table 3 shows that FMI and LBMI differ significantly in males and females but not the PP.

In this study, we examined the relationship between PP with LBMI and FMI in both genders. The BMI and Pulse pressure was not different significantly in males and females. This was so because in the age group of 18-25, in females, the fat deposition is more than that in the boys (although mean height is more),This is primarily due to hormonal differences. Estrogen, the predominant female hormone, promotes the accumulation of fat in certain areas like the hips and breasts, contributing to a more pronounced development of curves in females during this stage of life. Blood pressure values were significantly different

Table 1: Shows mean of variables male and female , where p<0.05 is considered as significant, n =no of participant mean of anthropometric parameters of male and female

	Male (n = 50)	Female (n = 50)	p-value
Age	20.84	20.34	0.1250(>0.05)
height	171.28	155.79	**<0.05**
weight	63.552	51.106	**<0.05**
BMI	21.71	20.88	0.234(>0.05)
LBMI	17.88888	15.67635	**<0.01**
FMI	5.135508	6.321921	**<0.01**
Systolic BP	118.8	109.72	**<0.05**
Diostolic BP	78.32	70.02	**<0.05**
Pulse pressure	40.84	39.76	**0.279>0.05**

Table 2: Shows correlation between Pulse pressure, systolic and diastolic BP with lean body mass index (LBMI) and fat mass index(FMI) in male and female

(Male)Pearson correlation (r) value of LMBI and FMI			
variables	**LBMI (r)**	**FMI (r)**	**p-value**
Pulse pressure	0.534864	0.465508	**<0.05**
Systolic BP	0.32375	0.311205	**<0.05**
Diastolic BP	-0.02007	0.0517	**<0.05**
(Female)Pearson correlation(r) value of LBMI and FMI			
Pulse pressure	0.449567	0.529892	**<0.05**
Systolic BP	0.40462	0.499523	**<0.05**
Diastolic BP	0.4733	0.559229	**<0.05**

Table 3: Shows correlation between LBMI, FMI, Pulse pressure in males and females, p-value <o.o5 considered as significant

	Male	Female	p-value
LBMI	17.88888	15.67635	**<0.01**
FMI	5.135508	6.321921	**<0.01**
PP	40.84	39.76	**0.279>0.05**

in male and female. The relationship between PP and lean body mass is positively correlated in both gender with slightly more correlation with males, the fact can be explained that having more muscle mass is likely linked to higher blood pressure levels[16]. Males have negative correlation of LBMI with diastolic bp thus increase PP. Muscle is generally seen as good for health, but it's unclear if there's a limit to its benefits. The more muscle you have, the higher your lean body mass, possibly influencing blood pressure[17]. Muscles release substances called myokines, including IL-1ß, IL-6, IL-8, IL-10 and TNF-a. If these myokines are consistently high in the body, it's been linked to diseases related to inflammation and problems with blood vessel function. These myokines might be the link between muscle mass and PPchanges, Lean body mass (LBM), primarily from muscles, is thought to protect against heart and metabolic issues, mortality, frailty and physical decline in the elderly.

This is attributed to improved insulin sensitivity, glucose metabolism and a reliable protein reserve. However, Berge HM *et al* systematic review[17], suggest that in certain populations, elevated muscle mass may lead to higher blood pressure or hypertension, as observed in retired American football players. In DH Lee *et al* study the association of predicted lean body mass and mortality from cardiovascular disease did not quite reach statistical significance (P-value for trend 0.10)[18], the results give support to our finding that high muscle mass may not be beneficial to cardiovascular health. There is also evidence that lipid depots within muscle cells (intramyocellular lipid, IMCL) are associated with risk of arterial stiffness and may thus be a risk factor for elevatedPP this can be explained as Fat tissue does more than store fat, it acts like an endocrine organ, producing substances like cytokines and hormones. These include TNF-α, IL-6, CRP, leptin, adiponectin and fatty acids[11]. Identification of IMCL droplets is possible with proton magnetic resonance spectroscopy but not with the bioimpedance method used in our study.

In men, PP was more strongly associated with LBMI than with FMI, whereas in women, the opposite was observed .Therefore, the sex differences in the association of FMI and LBMI with PP may be attributed to their different body composition characteristics although both FMI and LBMI shows positive correlation with PP in males and females. Previous studies have shown that men have a higher mean LBMI but a lower mean FMI than women, irrespective of age and ethnicity[19] supporting our study. This phenomenon may endorse that FMI is more relevant in the process of arterial stiffness in women, whereas LBMI is more critical in men's arterial stiffness process. Thus both the indices LBMI and FMI are important to monitor PP. Study is cross-sectional, which prevents us to define any causal relationships between LMI or FMI and PP levels. The age range of our study participants was 18-25 years, which limits the generalization of the results to other age groups. There is the potential for instrument bias in the bio impedance analyses for FMI and LMI. However, the multifrequency bio impedance technology used in our study with palm and sole electrodes has been shown to be sufficiently accurate

at the group level also in the age group of our study participants.

CONCLUSION

LBMI and FMI both shows a positive correlation with pulse pressure with LBMI more in males and FMI more in females. To maintain cardiovascular health, it's crucial to reduce overall obesity rather than solely focusing on increasing muscle mass. Staying active and adopting a healthy lifestyle are key factors for a thriving life.

REFERENCE

1. Mills, K.T., A. Stefanescu and J. He, 2020. The global epidemiology of hypertension. Nat. Rev. Nephrol., 16: 223-237.
2. Ose, D., J. Rochon, S.M. Campbell, M. Wensing and T. Freund *et al.,* 2013. Health-related quality of life and risk factor control: The importance of educational level in prevention of cardiovascular diseases. Eur. J. Public Health, 24: 679-684.
3. GBD 2015 Eastern Mediterranean Region Cardiovascular Disease Collaborators, 2018. Burden of cardiovascular diseases in the Eastern Mediterranean Region, 1990-2015: Findings from the Global Burden of Disease 2015 study. Int. J. Public Health, 63: 137-149.
4. Landi, F., R. Calvani, A. Picca, M. Tosato and A.M. Martone *et al.,* 2018. Body mass index is strongly associated with hypertension: Results from the longevity check-up 7+study. Nutrients, Vol. 10 .10.3390/nu10121976.
5. Kuwabara, M., R. Kuwabara, K. Niwa, I. Hisatome and G. Smits *et al.,* 2018. Different risk for hypertension, diabetes, dyslipidemia, and hyperuricemia according to level of body mass index in Japanese and American subjects. Nutrients, Vol. 10 .10.3390/nu10081011.
6. Kapetanakis, V.V., A.R. Rudnicka, A.K. Wathern, L. Lennon and O. Papacosta *et al.,* 2014. Adiposity in early, middle and later adult life and cardiometabolic risk markers in later life; findings from the british regional heart study. PLoS ONE, Vol. 9 .10.1371/journal.pone.0114289.
7. Lee, C.Y., W.T. Lin, S. Tsai, Y.C. Hung and P.W. Wu *et al.,* 2016. Association of parental overweight and cardiometabolic diseases and pediatric adiposity and lifestyle factors with cardiovascular risk factor clustering in adolescents. Nutrients, Vol. 8 .10.3390/nu8090567.
8. Crawford, A.G., C. Cote, J. Couto, M. Daskiran and C. Gunnarsson *et al.,* 2010. Prevalence of obesity, type ii diabetes mellitus, hyperlipidemia and hypertension in the united states: Findings from the ge centricity electronic medical record database. Popul. Health Manage., 13: 151-161.
9. Flegal, K.M. and B.I. Graubard, 2009. Estimates of excess deaths associated with body mass index and other anthropometric variables. Am. J. Clin. Nutr., 89: 1213-1219.
10. Pischon, T., 2010. Commentary: Use of the body mass index to assess the risk of health outcomes: Time to say goodbye? Int. J. Epidemiol., 39: 528-529.
11. Li, M., J. Lin, S. Liang, S. Huang, Z. Wen and Z. Mo, 2022. Predicted fat mass, lean body mass, and risk of hypertension: Results from a Chinese male cohort study. Obesity Facts, 15: 638-647.
12. Larsson, S.C., M. Bäck, J.M.B. Rees, A.M. Mason and S. Burgess, 2019. Body mass index and body composition in relation to 14 cardiovascular conditions in UK Biobank: A mendelian randomization study. Eur. Heart J., 41: 221-226.
13. Strandberg, T.E. and K. Pitkala, 2003. What is the most important component of blood pressure: Systolic, diastolic or pulse pressure? Curr. Opin. Nephrol. Hypertens., 12: 293-297.
14. Benetos, A., 1999. Pulse pressure and cardiovascular risk. J. Hypertens Suppl., 17: 21-21.
15. Mancia, G., G. De Backer, A. Dominiczak, R. Cifkova and R. Fagard *et al*., 2007. 2007 Guidelines for the management of arterial hypertension: The task force for the management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). J. Hypertens, 25: 1105-1187.
16. Vaziri, Y., S. Bulduk, Z. Shadman, E.O. Bulduk, M. Hedayati, H. Koc, F. Er and C.S. Erdogan, 2015. Lean body mass as a predictive value of hypertension in young adults in Ankara, Turkey. Iran J. Public Health, 44: 1643-1654.
17. Lee, D.H., N. Keum, F.B. Hu, E.J. Orav, E.B. Rimm, W.C. Willett and E.L. Giovannucci, 2018. Predicted lean body mass, fat mass and all cause and cause specific mortality in men: Prospective us cohort study. BMJ, Vol. 362 .10.1136/bmj.k2575.
18. Schweiger, V., D. Niederseer, C. Schmied, C. Attenhofer-Jost and S. Caselli, 2021. Athletes and hypertension. Curr. Cardiol. Rep., Vol. 23 .10.1007/s11886-021-01608-x.
19. Lu, Y., H. Shu, Y. Zheng, C. Li, M. Liu, Z. Chen and X. He, 2012. Comparison of fat-free mass index and fat mass index in Chinese adults. Eur. J. Clin. Nutr., 66: 1004-1007