

THE IMPACT OF ANTHROPOMETRIC MEASUREMENTS ON LIPID PROFILE IN NORMAL, OVERWEIGHT AND OBESE ADULTS WITH HYPERTENSION

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Abstract

Background and Aims: We investigated the association of anthropometric measurements with lipid profile in adult hypertensive patients with normal weight and overweight including obesity. **Materials and Method:** This was a randomized study performed in Tiaret, Algeria, on 150 hypertensive patients aged 33-91 years. Patients were divided according to their body weight (normal weight vs. overweight and obesity) into two groups. Weight, height and body mass index (BMI) were measured to estimate the various categories of body weight. The blood pressure (systolic and diastolic) and lipid profile (total cholesterol (TC), high-density lipoprotein cholesterol (HDL-c), low-density lipoprotein cholesterol (LDL-c) and triglycerides (TG) were analyzed. **Results:** We found significant relations between body weight and blood pressure. Patients with normal weight had a normal blood pressure. However, a significant increase in blood pressure was observed in patients with overweight and obesity. Numerous significant relationships were disclosed for TC and LDL-c. **Conclusion:** Lipid profile is related with weight status in hypertensive overweight/obese patients.

Key words: anthropometric measurements, lipid profile, hypertension, normal weight, overweight, obesity.

Background and aims

According to the World Health Organization (WHO) [1], hypertension is the most deadly cardiovascular risk factor; It represents a major public health problem in almost all regions of the globe [2]. In 2000, the estimated prevalence of hypertension was 26.4% (26.6% in men and

26.1% in women) and is expected to rise to 29.2% by 2025 (29% in men and 29.5% in women). Among the 972 million hypertensive adults, 333 million, or 34.3%, are from "developed" countries, and 639 million, or 65.7%, from "developing" countries [3]. Hypertension is also the third leading cause of death in Algeria (after malnutrition and

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smoking), similar to the global situation where it is responsible for 30% of deaths. Six million Algerians suffer from this silent disease, or 26-35% of adult subjects [4]. Lower blood pressure levels could theoretically be used to further reduce the risk of cardiovascular complications [5].

Hypertension is recognized also as a complication of overweight/obesity, with several studies showing a strong link between body weight and blood pressure. Hypertension is a multifactorial disease resulting from the interaction of genetic and environmental factors including nutritional factors. Numerous epidemiological studies have reported the relationship between lifestyle, diet and blood pressure in different populations [6]. Thus, changes in eating behaviors (reducing dietary intake of cholesterol, saturated fat and salt) can reduce blood pressure. These non-drug measures should be systematically integrated into the therapeutic approach as they act in a complementary manner [2].

The aim of our study was to analyze the relationship between anthropometric measurements and hypertension.

Materials and methods

The study was carried out in the Department of General Medicine, Hospital “*Boubekeur Khaled*” in Tiaret, North West of Algeria. We conducted a cross-sectional survey by questionnaire to first identify the weight status of patients and subsequently to assess the association of blood pressure and lipid profile with body weight.

The study included 150 patients (63 men and 87 women) aged 33-91 years admitted to the Public Establishment of Local Health in Tiaret for hypertension between November 2013 and May 2014. The participants were chosen randomly (patients that presented at the hospital for a consultation in a consecutive manner were

selected). Each participant had to fill in a questionnaire about their weight).

Inclusion and exclusion criteria

We included hypertensive subjects who live in the city of Tiaret, aged over 30 years, We recruited only patients consulted in the hospital who accepted to participate in the study after receiving an explanation of its objectives. We excluded all hypertensive patients suffering from another disease or a complication of hypertension. We have included hypertensive subjects that were under treatment, but we excluded patients with resistant hypertension, defined as blood pressure values which remained high despite the concomitant use of three antihypertensive drugs, according to the guidelines [7,8]. None of the participants used any vitamins, mineral supplements or oral contraceptives. None of the females were pregnant or breastfeeding.

Anthropometric measurements

Measurement of body weight (in kilograms) was performed using an electronic balance, and height (in meters) was measured using a body stadiometer. Body mass index (kg/m^2) was calculated by weight (in kilograms) divided by the square of height (in meters). Adults were classified according to their BMI into two groups: normal weight (BMI: 18.5–24.9 kg/m^2) and overweight (BMI: 25.0–29.9 kg/m^2) including obese (BMI: $> 30 \text{ kg/m}^2$).

Blood pressure measurement

Blood pressure measurements were made in the presence of the attending physician. OMRON® Digital Automatic Blood Pressure Monitor was used for measuring the blood pressure. We have performed three readings and considered the average of readings as the patient blood pressure. The measurements are expressed in millimeters of mercury (Hg). Normal blood

pressure is defined as a systolic blood pressure between 120 and 139 mmHg and/or diastolic blood pressure 80 to 89 mmHg. Above these values, we could diagnose hypertension.

After blood pressure measurement, a questionnaire was distributed to patients in order to learn about their socio-economic status, physical activity, as well as their usual daily food intake. We used a 24 h reminder to estimate dietary intake of the subjects surveyed. After collecting the data from our study, we opted for the division of the population into two groups according to BMI: Group 1: normal weight; Group 2: overweight and obesity.

Blood sampling

In the morning, venous blood samples were drawn after a 12 hours of fasting from each participant for biochemical determinations. Blood had been centrifuged for plasma separation. Enzymatic colorimetric methods were used to determine the serum concentrations of total cholesterol (TC), high-density

lipoprotein cholesterol (HDL-c), low-density lipoprotein cholesterol (LDL-c) and triglycerides (TG).

Statistical analyses

Data were expressed as mean \pm SD. We used SPSS 20.0 for Windows (SPSS[®] Inc., Chicago, IL, USA) for statistical analyses. A p-value $<$ 0.05 was considered statistically significant with a confidence interval of 95 %. The student t-test was used to compare means of anthropometric measurement and blood parameters between groups and the Chi-square test was used for comparing percentage values.

Results

[Figure 1](#) shows the distribution of population by age and sex. The average age of the surveyed population was 57.11 ± 10.12 years with a minimum age of 33 years and a maximum age of 91 years. Males presented an average age of 58.17 ± 10.72 years and females 52.18 ± 11.73 years.

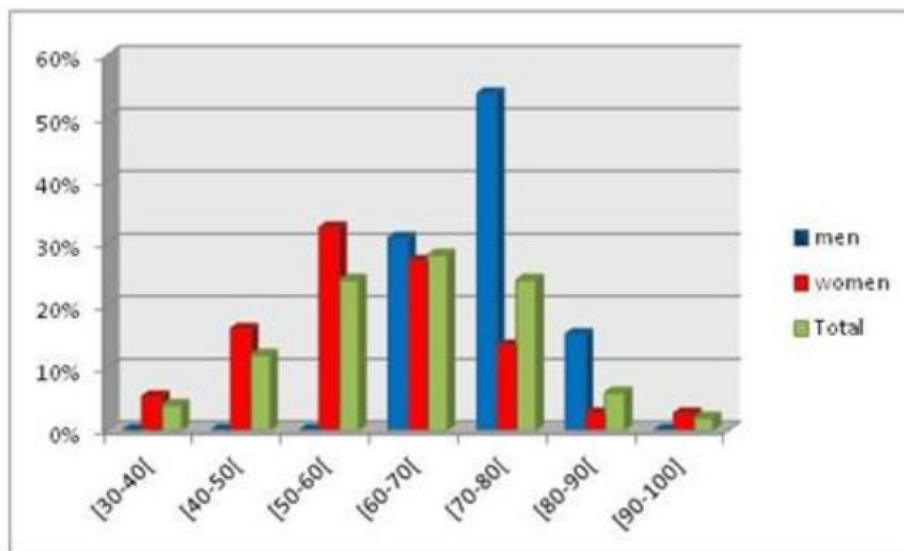


Figure 1. Distribution of study population by age and sex.

The average systolic blood pressure of the study population was 130.50 ± 16.50 mmHg, with a maximum value of 160 mm Hg and a minimum value of 110 mmHg. The average systolic blood pressure for men was $138.50 \pm$

15.70 mmHg with a maximum of 160 mmHg and a minimum of 110 mmHg. In women, the average systolic blood pressure was 133.80 ± 16.80 mmHg with a maximum of 160 mmHg and a minimum of 110 mmHg. The systolic

blood pressure varied between 130 mmHg in the age group 30-40 years and 160 mm Hg in the age group (90-100) years. We give in [Table 1](#) the

mean values for weight, height and BMI according to sex.

Table 1. Mean values of weight, height and BMI of our study population.

Anthropometric parameters	Total			Men			Women			P-value
	Mean±SD	Min	Max	Mean±SD	Min	Max	Mean±SD	Min	Max	
weight (kg)	75.24±13.59	49	104	76.62±13.18	51	104	74.65±13.86	49	102	0.023
height (cm)	166.08±5.39	155	176	172.31±2.65	168	176	163.68±4.27	155	175	0.057
BMI (kg/m ²)	26.80±4.71	17	37.5	25.38±4.33	17	35.2	27.02±4.51	19	37.5	0.053

Table 2. Blood pressure according to the body weight.

B.P(mmHg)	Total		Men		Women		p-value (Men vs. Women)
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	
Underweight	120.00±00.00	70.00±00.00	120.00±00.00	70.00±00.00	-	-	0.064
Normal	128.10±11.20	80.60±11.20	130.00±15.80	78.00±04.50	127.30±18.50	81.80±13.20	0.72
Overweight	140.50±17.90	87.50±09.60	152.00±08.30	90.00±07.00	136.70±18.70	86.70±10.40	0.034
Obesity	136.20±10.40	85.80±09.50	135.00±07.00	80.00±00.00	136.40±11.20	86.80±10.00	0.025

Table 3. Biochemical parameters of the population.

Variables	Total	Men	Women	p-value
TC (mg/dl)	153±38	145±23	156±45	0.070
HDL-c (mg/dl)	30±9	32±1	29±1.1	0.033
LDL-c (mg/dl)	122±32	134±34	111±23	0.068
TG (mg/dl)	166±54	156±63	170±23	0.66

The lipid profiles of subjects according to gender are shown in [Table 3](#). The main finding was a significantly higher HDL-c in males compared to women.

Overall we recorded 97 subjects with normal weight status (50 women and 47 men), representing 64.66% of the total population. In total 53 subjects (29 men and 24 women), representing 35.33% of the population were overweight and obese. In men, the dominant class of BMI category was overweight with a

percentage of 38.47%, and 38.46% had normal weight. For women, the dominant class of BMI category was overweight with a percentage of 40.54%.

We found that hypertensive patients who have a normal weight or are underweight have normal/low blood pressure. Blood pressure was significantly higher in patients who are overweight or obese, as shown in [Table 2](#).

Table 4 shows the results of the lipid profiles of subjects according to the weight status. As

detailed, subjects with overweight/obesity had significantly higher total cholesterol, LDL-c and triglycerides and significantly lower HDL-c.

Table 4. Biochemical parameters according the weight status.

Variables	Total	Normal weight	Overweight/obesity	p-value
TC (mg/dl)	153±38	121±33	156±45	0.003
HDL-c (mg/dl)	30±9	43±1.3	32±1.7	0.045
LDL-c (mg/dl)	122±32	135±74	167±13	0.0013
TG (mg/dl)	166±54	152±53	188±33	0.034

Discussion

Hypertension is responsible for slightly less than 8 million deaths per year worldwide. It is the cause of nearly half of strokes and heart attacks [9]. The increasing prevalence of overweight and obesity is becoming a major public health crisis owing to its upsurge association with risk of major chronic diseases, such as hypertension [10]. It is well established that factors like poor diet, sedentary lifestyle and smoking represent risk factors for hypertension [11]. The purpose of the present study was to investigate the relationship between weight status and plasma lipid parameters (TC, HDL-c, LDL-c and TG) in hypertensive subjects. Our results are in consistency with data of many studies [12,13] showing that males are taller and heavier as compared to females. However, females have higher BMI values.

Patients with hypertension tend to have a low socioeconomic status. For example, in our study 83.33 % had no occupation, 70 % were illiterate and 80 % came from a large family. In addition, these patients live in precarious conditions and almost 70 % live in communal houses. These conditions have a decisive influence on the diet of patients (poor nutrition). This is concordant with other published results showing that the prevalence of hypertension is inversely related to the level of education and the

social environment: farmers, workers and the less educated are those who are diagnosed most often with hypertension [14]. The frequency of poorly controlled blood pressure values was reported to be significantly greater in men [15].

Women are more often aware of their hypertension diagnosis than men [16]. This study showed that the rate of obese women is two times greater than that of men (24.32% versus 7.69%). Obese adults aged 25 to 45 are at risk of developing hypertension 5-6 times greater than the lean subjects. Obesity is considered one of the most important cardiovascular risk factors that causes and maintains other risk factors such as hypertension [17]. Body weight is not only regarded as a risk factor for hypertension, but also a parameter that controls the health status of hypertensive patients, the progression of the disease and the treatment of the disease.

Cross-sectional and prospective epidemiological studies have shown that blood pressure and, worse still, hypertension increase significantly with higher body mass index (BMI) and waist circumference (WC) [18]. The rules for a healthy lifestyle and eating habits can sometimes be enough to normalize blood pressure and must always be available. These recommendations include: weight loss [19], aiming to maintain BMI below 25 kg/m², or at least to obtain a reduction of 10 % of initial weight; decreased consumption of salt, if

possible less than 6 g/day [20], increased consumption of dietary fiber, especially with a diet rich in vegetables and fruits, and reduce that of fat, especially the saturated fats (thus, it was shown that a vegetarian diet reduces blood pressure by 4.8 mmHg in average); increasing potassium consumption; fight against well-known hypertension risk factors (smoking, high cholesterol levels, diabetes, physical inactivity); use a low-dose estrogen pill. The reduction in these risk factors is recommended to prevent and/or treat hypertension [21].

We analysed the impact of anthropometric measurements on lipid profile in the two groups of our study population. Normal values lipid indexes were disclosed in normal weight group, however, there is an increase in these values in the overweight group including obesity. This trend of increased lipid values according to weight was statistically significant, with no difference by gender. This may be due to the increased risk of metabolic abnormalities linked to overweight and obesity. However, other risk factors such as genetic predisposition, sedentary lifestyles, and consumption of fatty foods can aggravate the situation.

It should be noted that cases with causes of secondary hypertension like diabetes mellitus, chronic renal failure, obesity, smoking, alcoholism & drugs were eliminated from the study, hence our results may vary slightly from other studies which have included all these factors. According to a study conducted by Prameela Devi et al., metabolic disturbances are common in hypertensives, so the blood test to measure the lipid profile of patients with hypertension is an essential part of their management [22]. We must encourage a healthy

change in lifestyle, diet and physical activity in hypertensive patients

Our study shows that lipid abnormalities can be much more important in hypertensives who suffer from overweight or obesity. However, it should be noted that this study has several limitations, including a small sample size, selection of patients from only one area of the country and that subjects were not-randomized from the general population. Replication of such studies in other regions and with a larger sample in order to cover the different departments of the country is required.

Conclusion

In 150 hypertensive patients we found elevated levels of TC, LDL-c and TG in the overweight/obesity group compared with normal weight subjects. In addition, we also found a significant decrease in HDL-c. The relationship between body weight and lipid profile of hypertensive patients in our study was not influenced by gender. This proves the importance of losing weight for hypertensive subjects in order to improve the lipid values. A modest weight loss, especially when maintained over time, significantly reduces the risk associated with hyperlipidemia in overweight adults.

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Conflict of interest. We declare that there is no conflict of interest.

REFERENCES

1. World Health Organization (WHO). 1999 World Health Organization-International Society of

Hypertension Guidelines for the Management of Hypertension. Guidelines Subcommittee. *J Hypertens* 17: 151-183, 1999.

2. **Blacher J, Czernichow S, Iaria P.** Traitement non pharmacologique de l'hypertension artérielle, *EMC-Cardiologie-Angéiologie* 2: 136-151, 2005. Accessed at: <http://www.sciencedirect.com/science/article/pii/S1762613705000060>.

3. **Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J.** Global Burden of hypertension: analysis of worldwide data. *Lancet* 365(9455): 217-223, 2005.

4. **Temmar M, Labat C, Benkhedda S et al.** Prevalence and determinants of hypertension in the Algerian Sahara. *J Hypertens* 25: 2218-2226, 2007.

5. **Arguedas JA, Perez MI, Wright JM.** Treatment blood pressure targets for hypertension. *Cochrane Database Syst Rev* 3: CD004349, 2009.

6. **Geronooz I, Krzesinski JM.** Obésité et hypertension artérielle: de la physiopathologie au traitement. *Rev Méd Liège* 55: 921-928, 2000.

7. **Calhoun DA, Jones D, Textor S et al.** Resistant hypertension: Diagnosis, evaluation, and treatment: a scientific statement from the American Heart Association Professional Education Committee of the Council for High Blood Pressure Research. *Circulation* 117: e510-e526, 2008.

8. **Brown MA, Buddle ML, Martin A.** Is resistant hypertension really resistant? *Am J Hypertens* 14: 1263-1269, 2001.

9. **Lawes C, Vander Hoorn S, Rodgers A. International Society of Hypertension.** Global burden of blood-pressure-related disease, 2001. *Lancet* 371(9623): 1513-1518, 2008.

10. **Pelkman CL, Fishell VK, Maddox DH, Pearson TA, Mauger DT, Kris-Etherton PM.** Effects of moderate-fat (from monounsaturated fat) and low-fat weight-loss diets on the serum lipid profile in overweight and obese men and women. *Am J Clin Nutr* 79: 204-212, 2004.

11. **Hansmaennel G.** Tabagisme, surcharge pondérale, hypertension artérielle et alcoolisme chronique chez 218 conducteurs de poids lourds ou d'engins. *Archives des maladies professionnelles et de médecine du travail* 56: 486-488, 1995. Accessed at <http://cat.inist.fr/?aModele=afficheN&cpsid=3688915>.

12. **Cox-York KA, Sharp TA, Stotz SA, Bessesen DH, Pagliassotti MJ, Horton TJ.** The effects of sex, metabolic syndrome and exercise on postprandial lipemia. *Metabolism* 62: 244-254, 2013.

13. **Fogal AS, Franceschini Sdo C, Priore SE, Cotta RM, Ribeiro AQ.** Stature estimation using the knee height measurement amongst Brazilian elderly. *Nutr Hosp* 31: 829-834, 2015.

14. **Frérot L, Lefur PH, Lepape A, Sermet C.** L'hypertension artérielle en France: Prévalence et prise en charge thérapeutique. *Bulletin d'information en économie de la santé* 22: 1-6, 1999. Accessed at <http://www.irdes.fr/Publications/Qes/Qes22.pdf>

15. **Yaméogo NV, Samadoulougou AK, Kagambèga LJ et al.** Caractéristiques épidémiocliniques de l'hypertension artérielle résistante du sujet noir africain. *Ann Cardiol Angeiol* 63: 83-88, 2014.

16. **Godet-Thobie H, Vernay M, Noukpoape A.** Niveau tensionnel moyen et prévalence de l'hypertension artérielle chez les adultes de 18 à 74 ans. BEH thématique; 49-50, 2008. Accessed at: http://opac.invs.sante.fr/doc_num.php?explnum_id=1389

17. **Turpin C, Brukert E.** Hypercholestérolémie, Masson (ed), Paris, France, pp 132-146, 1999.

18. **Williams PT.** Increases in weight and body size increase the odds for hypertension during 7 years of follow-up. *Obesity* 16: 2541-2548, 2008.

19. **Horvath K, Jeitler K, Siering U et al.** Long-term effects of weight-reducing interventions in hypertensive patients, systematic review and meta-analysis. *Arch Intern Med* 168: 571-580, 2008.

20. **He FJ, Li J, MacGregor GA.** Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomised trials. *BMJ* 346: f1325, 2013.

21. **Appel LJ, Moore TJ, Obarzanek E et al.** A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. *N Engl J Med* 336: 1117-1124, 1997.

22. **Pramiladevi R, Gooranavar SM, Biradar Satish B, Baragundi Mahesh C, Kora SA, Narayan M.** Study of lipid profile in hypertensive patients in rural Karnataka. *JPBMS* 7: 1-6, 2011. Accessed at http://www.jpbums.info/index.php?option=com_docman&task=doc_download&gid=188&Itemid=48.