MEAN ARTERIAL PRESSURE NEW AND PERSPECTIVE INDICATOR FOR METABOLIC SYNDROME

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Purpose

Objectives of this study were to evaluate opportunities of using of mean arterial pressure (MAP) as a component of the metabolic syndrome (MS) instead systolic and diastolic blood pressures (SBP and DBP) and to create a model, using logistic regression.

Methods

A total of 104 persons without any apparent disease were selected. Among these people MS was found in 35, according to NCEP-ATP III definition. One way ANOVA test, multiple comparison tests of means and multiple logistic regression analyses were used. The MAP was obtained by the formula MAP=SBP/3+2*DBP/3.

Results

The mean values and standard deviations of the clinical characteristics of the investigated individuals were obtained (Table 1). There were clear differences between mean values of SBP, DBP and MAP for people with and without metabolic syndrome. The average value of mean arterial pressure for all persons was 95.17 [mm Hg] and the standard deviation was 10.65 [mm Hg].

The mean values of SBP, DBP and MAP in three age groups for men and women were shown on Figures from 1 to 6. The analysis of results indicated that the variation of values of the mean values were relatively small with the age for men. The mean values increased with the age for women, but the changing wasn't so great. The results showed that the age wasn't a major factor influencing on mean values of blood pressures.

The four groups used in ANOVA were men and women with and without MS. The ANOVA F-statistic is 17.71 with p-value less than 0.00001 (Table 2). The box plot of ANOVA was shown on Figure 7. The multiple comparison tests showed statistically significant differences between groups of people with and without MS and negligible differences between men and women (Table 3). Regarding MAP, the differences between the groups of men and women with MS, as well as between the groups of men and women without MS are small. There was a statistically significant difference between the persons with MS and the health ones, irrespective of the gender. For the women, the difference between the mean values of MAP for those with MS and those without MS was greater than the differences registered between the respective groups of men. These results confirmed that the mean arterial pressure is a major risk factor, and it is better expressed in females as compared to males.

Multiple logistic regressions were used to determine odds ratio (OR) of MS. The first model included the following components of MS - waist (WS), HDL cholesterol, blood glucose (GLU) and serum triglycerides (TG). The second model included WS and TG. MAP was used as the last variable in the both models:

(1) $$\text{Logit}(P) = \ln\left(\frac{P}{1-P}\right) = b_0 + b_1 * WS + b_2 * GLU + b_3 * TG + b_4 * HDL + b_5 * MAP;$$

(2) $$\text{Logit}(P) = \ln\left(\frac{P}{1-P}\right) = b_0 + b_1 * WS + b_2 * TG + b_3 * MAP.$$

All dependent variables, except MAP, were dichotomous. Each dichotomous variable received value 1 if the criterion for corresponding component in definition was met. The p-values for overall models fit statistic was less than 0.00001. The values of regression coefficients and corresponding p-values were calculated (Table 4). Thresholds for OR above which the decision about presence of MS should be made, were found (Table 4). There were two types of wrong decisions. The first was when a healthy person was determined as a one with metabolic syndrome. The second was when a person with metabolic syndrome was determined as healthy one. When the first model was used with threshold for OR equal to 1 there were 1 wrong decision of first type and 2 wrong decisions of second type. The relative mistakes were respectively 1.45% and 5.71%. The model showed very good results regarding the NCEP-ATP III definition of metabolic syndrome. When the second model was used with threshold for OR equal to 0.82 there were 3 wrong decision of first type and 2 wrong decisions of second type. The relative mistakes were respectively 4.35% and 5.71%. This model also showed very good results regarding the NCEP-ATP III definition of metabolic syndrome. The basic advantage of the second model was the using only of one biochemical marker.

The analysis of the first model indicated that increasing of MAP with 1% (0.9517 mm Hg) of its mean value resulted in 2.2 times increase of OR. When the second model was used increasing of MAP with 1% of its mean value resulted in 1.5 times increase of OR. This indicated the significance of MAP as a component of metabolic syndrome.

The results showed that increasing of SBP with 10% (13 mm Hg) of its mean value led to 1.78 times growth of OR for men and 2.16 times for women. The increasing of OR for the model with DBP (increasing with 8.2 mm Hg) were respectively 1.13 times and 2.19 times. In these models the increasing of blood pressures with value around 10 times greater than increasing of MAP in proposed here models led to almost one and the same growth of OR. This comparison was another proof that MAP is much stronger marker of metabolic syndrome than SBP and DBP.

Conclusions

The results indicated strong relation between value of MAP and MS. The proposed model showed a reliable determination of MS, using only one biochemical marker. Reducing the number of used biochemical marker could improve the cost efficiency in the diagnostication of MS. MAP showed itself as a promising indicator, which after some broader studies could replace SBP and DBP in the MS definition.

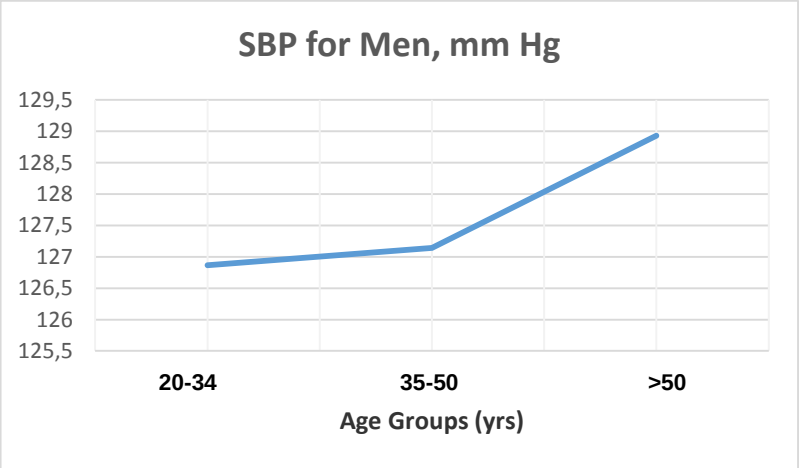

Figure 1

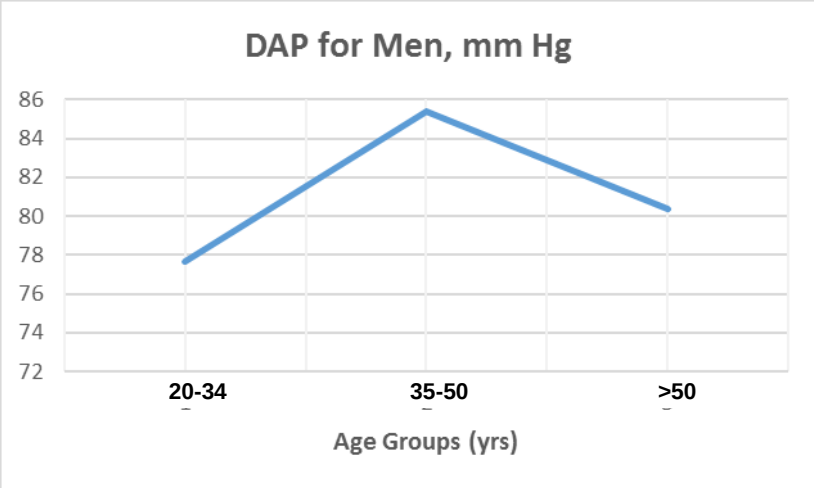

Figure 2

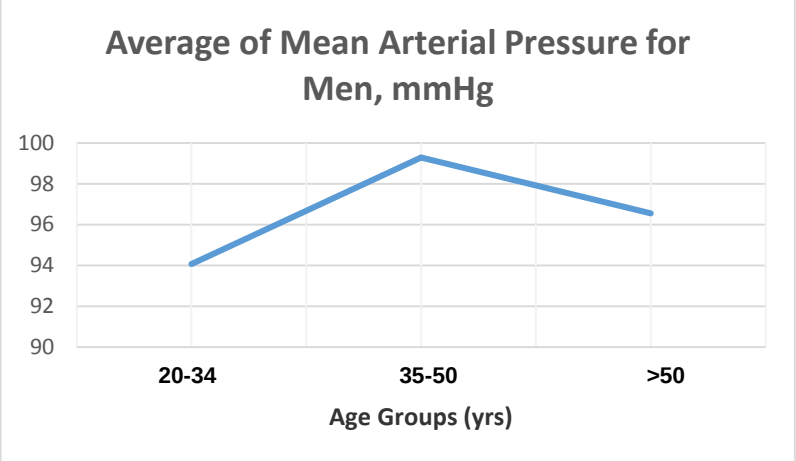

Figure 3

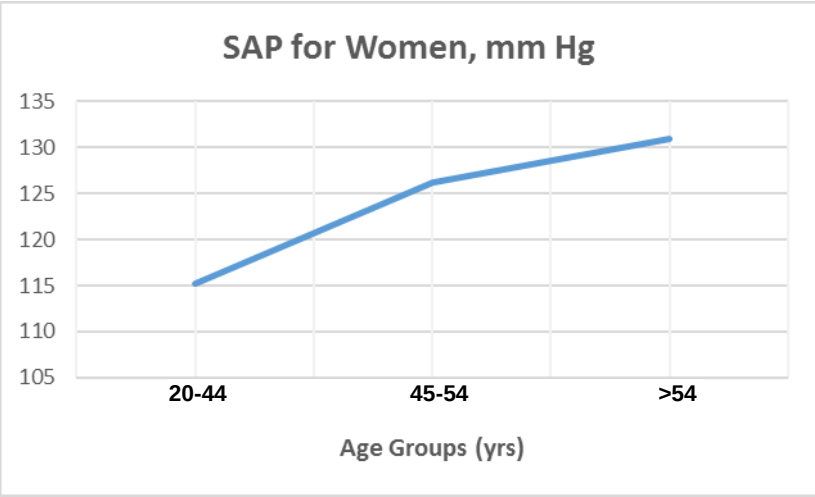

Figure 4

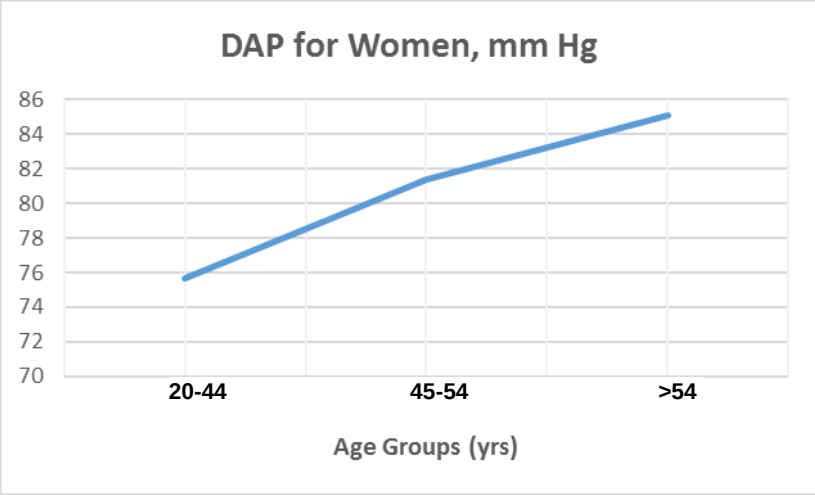

Figure 5

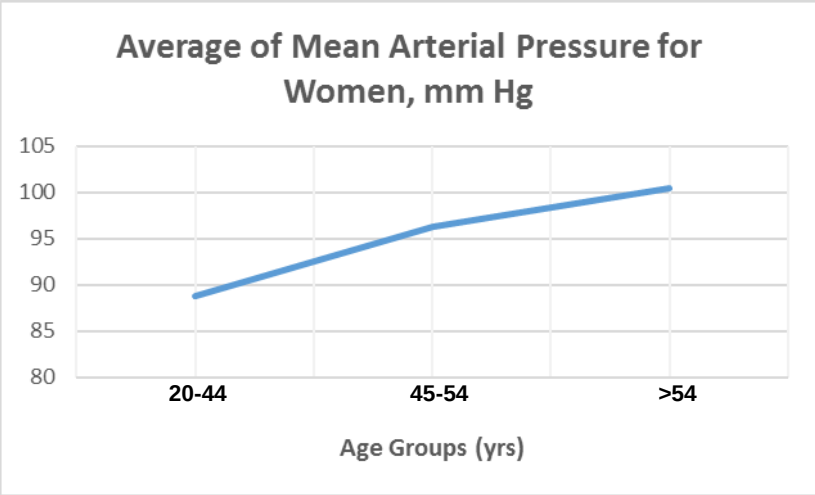

Figure 6

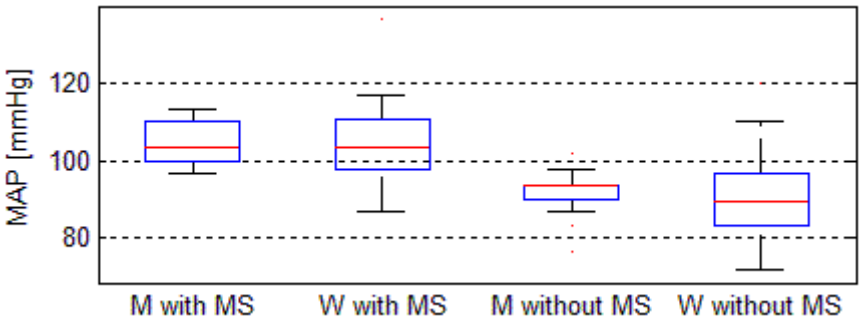

Figure 7

Table 1. Clinical characteristics of the participants.

Characteristics	Group with MetS		Group without MetS	
	Mean value	SD	Mean value	SD
Waist circumference [cm]	98.36	±8.38	82.81	±13.76
SBP [mm Hg]	136.57	±16.28	119.43	±11.82
DBP [mm Hg]	87.85	±8.19	77.39	±9.11
MAP [mm Hg]	103.90	±9.38	90.73	±8.29
APO B [mg/dl]	92.39	±29.63	103.88	±24.2
APO A1 [mg/dl]	172.19	±33.73	169.22	±34.04
LDL - cholesterol [mmol/l]	3.41	±1.27	3.73	±1.02
HDL - cholesterol [mmol/l]	1.37	±0.41	1.17	±0.3
Blood sugar [mmol/l]	4.83	±1.3	5.45	±1.69
Total cholesterol [mmol/l]	5.34	±1.5	5.79	±1.21
hs-CRP [mg/l]	2.52	±2.99	4.24	±3.95
Triglyceride levels [mmol/l]	1.85	±1.93	2.89	±2.86
HbA1C [%]	5.32	±0.3	5.51	±0.23
BMI [kg/m2]	27.06	±5.38	31.48	±4.37

Table 2. Data from ANOVA analysis of MAP.

Deviations	Sum of squares	Degrees of freedom	Mean value	F-test statistic	p-value
Between groups	4055.26	3	1351.75	17.71	<0.00001
Within groups	7633.407	101	76.33407		
Total	11688.67	104			

Table 3. Data from multiple component analysis of MAP by gender.

Group One	Group Two	Lowest value of CI [mm Hg]	Difference between means [mm Hg]	Highest value of CI [mm Hg]
Men with MS	Women with MS	-7.83656	0.039683	7.915929
Men with MS	Men without MS	4.892007	12.41005	19.9281
Women with MS	Women without MS	7.557816	13.65873	19.75964
Men without MS	Women without MS	-4.34253	1.28836	6.919248

Table 4. Coefficients of the two logistic regression models.

		Model 1					Model 2			
Coefficients	b0	b_1	b_2	b_3	b_4	b_5	b0	b_1	b_2	b_3
	-97.86	10.55	8.41	11.35	8.28	0.83	-49.16	6.42	8.24	0.42
p	0.015	0.025	0.035	0.021	0.047	0.016	0.0008	0.005	0.002	0.001
Thresholds	1						0.82			
Wrong decisions	with MS	1 (1.45%)					3 (4.35%)			
	without MS	2 (5.71%)					2 (5.71%)			

СРЕДНОТО АРТЕРИАЛНО НАЛЯГАНЕ НОВ И ПЕРСПЕКТИВЕН ИНДИКАТОР ЗА МЕТАБОЛИТЕН СИНДРОМ.

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Цел

Целта на това проучване е оценка на възможностите за използване на средното артериално налягане (СрАН), като компонент на метаболитния синдром (МС), посредством създаване на модел, който използва логистичната регресия, вместо систолното и диастолното артериално налягане (САН и ДАН).

Методи

Проведено е изследване сред 104 участници без клинично проявени заболявания. Метаболитният синдром, според дефиницията на NCEP-ATP III е диагностициран при 35 от тях. Използвани са ANOVA тест, многофакторен анализ и множествена логистична регресия. Средното артериално налягане е определено по формулата СрАН=САН/3+2*ДАН/3.

Резултати

Определени са средните стойности и стандартните отклонения на клиничните характеристики на изследваните лица (Табл. 1). Наблюдавани са отчетливи разлики между средните стойности на САН и ДАН за лицата с и без МС. Получени са средната стойност на средното артериално налягане за всички лица 95,17 ммHg и стандартно отклонение 10,65 мм Hg.
Средните стойности на САН, ДАН и СрАН за трите възрастови групи за мъже и жени са показани на фигурите от 1 до 6.
Четирите групи участници, използвани в ANOVA са мъже и жени с и без МС. От ANOVA F = 17,71 с p<0,00001 (Таблица 2). Резултатите от ANOVA са показани на фигура 7. Наблюдават се статистически значими разлики между групите от хора с и без МС и незначителни разлики между мъжете и жените (Таблица 3). По отношение на СрАН, разликите между групите за мъжете и жените с МС, както и между групите на мъжете и жените без МС са незначителни. Статистически значими разлики има между лицата с МС и тези без МС, независимо от пола.

За жените, разликата между средните стойности на СрАН за тези с МС и тези без МС е по-голяма, отколкото разликите регистрирани между съответните групи участници. Тези резултати потвърдиха, че СрАН е основен рисков фактор и е по-добре изразен при жените в сравнение с мъжете.

Използвана е множествена логистична регресия за определяне на отношенията на шансовете (OR) за МС. Първият модел включва следните компоненти на МС - талия (WS), HDL холестерол, кръвна захар (Glu) и серумни триглицериди (TG). Във вторият модел са включени WS и TG. Средното артериално налягане е използвано като променлива в двата модела:

(1) $$\text{Logit}(P) = \ln\left(\frac{P}{1-P}\right) = b_0 + b_1 * WS + b_2 * GLU + b_3 * TG + b_4 * HDL + b_5 * MAP;$$

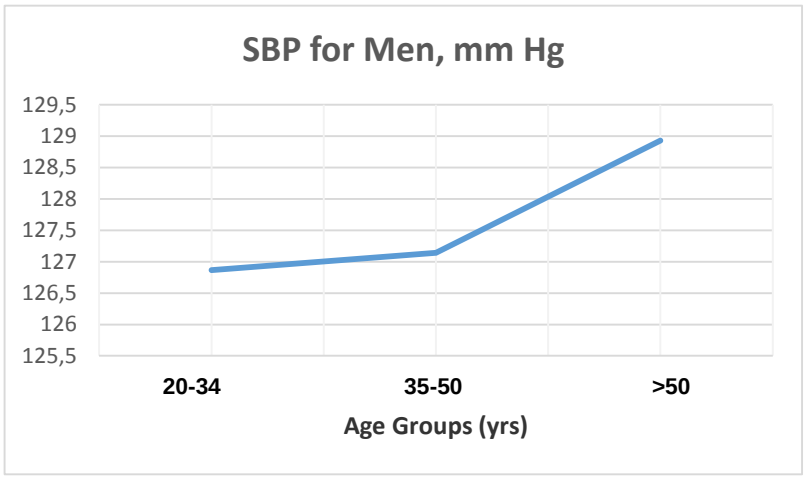
(2) $$\text{Logit}(P) = \ln\left(\frac{P}{1-P}\right) = b_0 + b_1 * WS + b_2 * TG + b_3 * MAP.$$

Всички зависими променливи с изключение на СрАН са дихотомни. Всяка дихотомна променлива има стойност 1. От F са получава p< 0,00001. Изчислени са стойностите на регресионните коефициенти и съответните p, а също така са определени и OR за МС (Таблица 4). В модел 1 OR нараства 2,2 пъти при увеличаване на СрАН с 1% от средната стойност, а в модел 2 OR нараства1,5 пъти при увеличаване на СрАН с 1% от средната стойност.

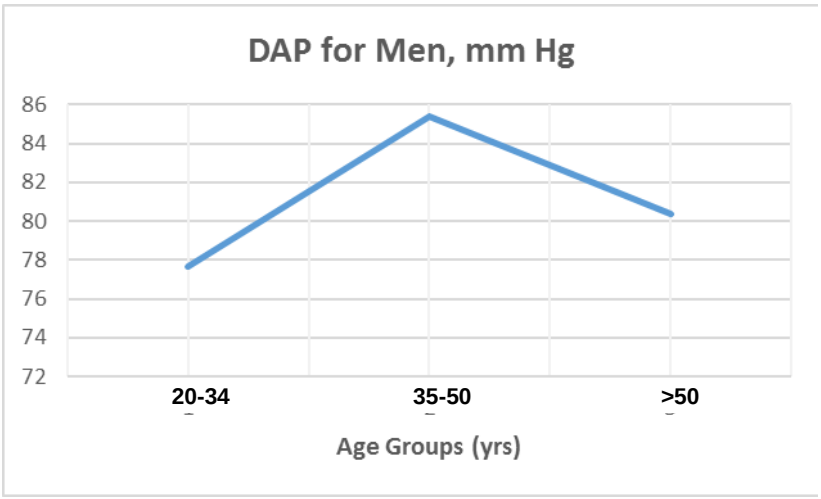
Заключения

Резултатите показват силна връзка между стойностите на СрАН и МС. От предложеният модел е видно, че СрАН оказва значение за надеждно диагностициране на МС, като се използва само един биохимичен маркер. Ефективността на разходите за определяне на МС може да бъде усъвършенствана с намаляването на броя на използваните биохимични маркери. Проведеното проучване демонстрира, че СрАН

може да се използва като перспективен индикатор за МС и би могло да замени САН и ДАН след задълбочени изследвания.



Фигура 1



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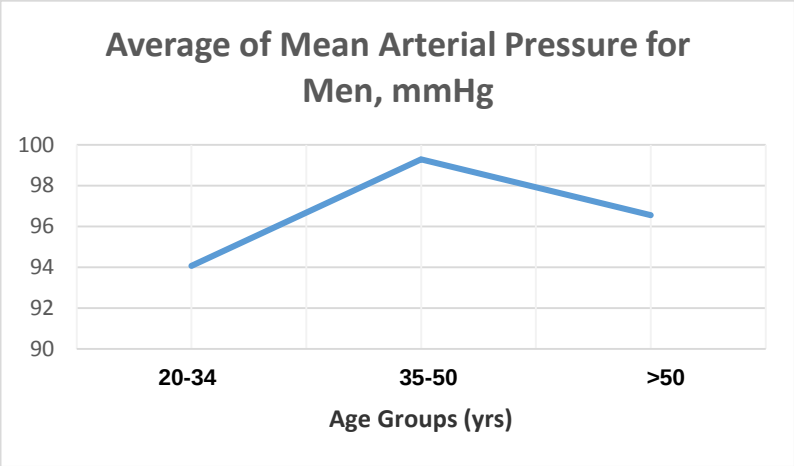

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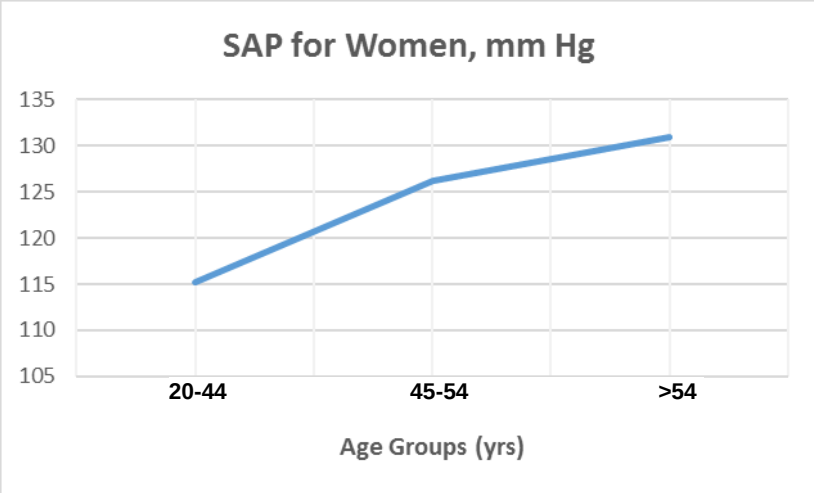

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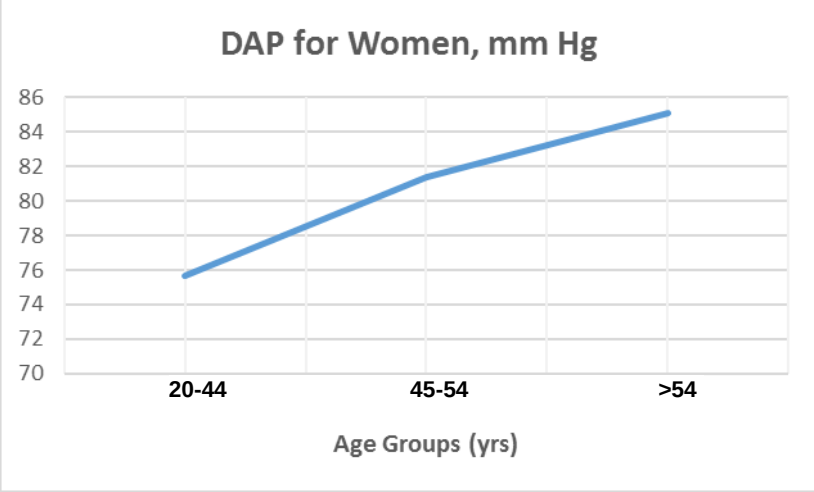

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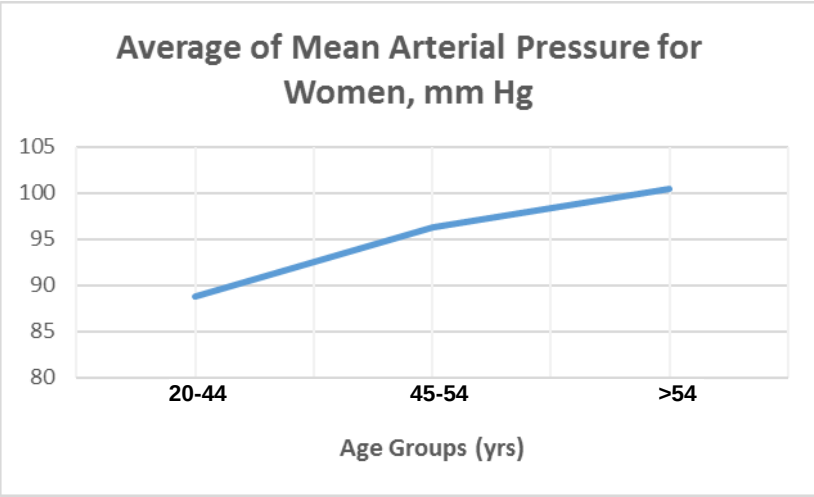
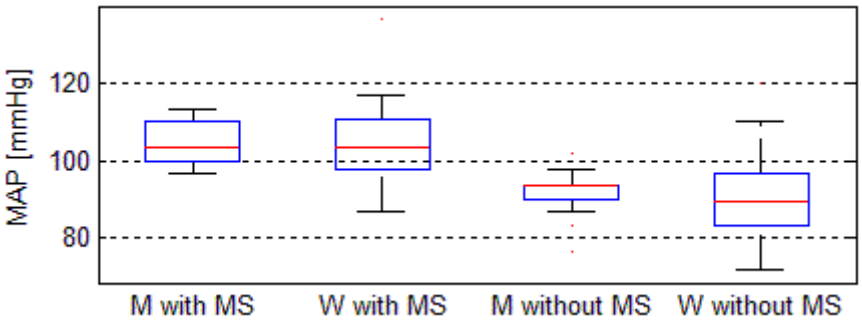


Фигура 6



Фигура 7

Таблица 1. Клинични характеристики на участниците.

Характеристики	Група с МС		Група без МС	
	Средна стойност	SD	Средна стойност	SD
Талия [cm]	98,36	±8,38	82,81	±13,76
САН [mm Hg]	136,57	±16,28	119,43	±11,82
ДАН [mm Hg]	87,85	±8,19	77,39	±9,11
СрАН[mm Hg]	103,90	±9,38	90,73	±8,29
APO B [mg/dl]	92,39	±29,63	103,88	±24,2
APO A1 [mg/dl]	172,19	±33,73	169,22	±34,04
LDL - холестерол [mmol/l]	3,41	±1,27	3,73	±1,02
HDL – холестерол [mmol/l]	1,37	±0,41	1,17	±0,3
Кръвна захар [mmol/l]	4,83	±1,3	5,45	±1,69
Общ холестерол [mmol/l]	5,34	±1,5	5,79	±1,21
hs-CRP [mg/l]	2,52	±2,99	4,24	±3,95
Триглицериди [mmol/l]	1,85	±1,93	2,89	±2,86
HbA1C [%]	5,32	±0,3	5,51	±0,23
BMI [kg/m2]	27,06	±5,38	31,48	±4,37

Таблица 2. Данни от ANOVA анализа на СрАН.

Девиации	Сума от квадр.	Степени на свобода	Средна стойност	F-статистика	p-стойност
Между групите	4055,26	3	1351,75	17,71	<0.00001
В групите	7633,407	101	76,33407		
Общо	11688,67	104			

Таблица 3. Данни от множествения компонентен анализ на СрАН по пол.

Първа група	Втора група	Най-ниска стойност на CI [mm Hg]	Разлики между СрАН [mm Hg]	Най-високи стойности на CI [mm Hg]
Мъже с МС	Жени с МС	-7,83656	0,039683	7,915929
Мъже с МС	Мъже без МС	4,892007	12,41005	19,9281
Жени с МС	Жени без МС	7,557816	13,65873	19,75964
Мъже без МС	Жени без МС	-4,34253	1,28836	6,919248

Таблица 4. Коефициенти на двата логистични регресионни модела.

	Модел 1						Модел 2			
Коефициенти	b0	b_1	b_2	b_3	b_4	b_5	b0	b_1	b_2	b_3
	-97,86	10,55	8,41	11,35	8,28	0,83	-49,16	6,42	8,24	0,42
p	0,015	0,025	0,035	0,021	0,047	0,016	0,0008	0,005	0,002	0,001
Граници	1						0,82			
Грешки	с МС	1 (1,45%)					3 (4,35%)			
	без МС	2 (5,71%)					2 (5,71%)			