MetS and cardiovascular risk factors among Palestinians of East Jerusalem

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المتلازمة الاستقلابية وعوامل الخطر القلبي الوعائي بين الفلسطينيين في القدس الشرقية

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الخلاصة: تعرف الباحثون من خلال هذا المسح العَرْضيّ الذي أجروه عام 2005 على معدل انتشار الملازمة الاستقلابية، وغيرها من عوامل الخطر القلبي الوعائي لدى 342 فلسطينياً تزيد أعمارهم على 20 عاماً في القدس الشرقية. وقد أجرى الباحثون مقابلات مع المشاركين في الدراسة، مع إجراء القياسات البشرية وفحوصات للدم. واكتشف الباحثون وجود المتلازمة الاستقلابية لدى 115 مشاركاً (33.6٪) دون وجود تفاوت واضح بين الجنسين. كما كانت معدلات انتشار البدانة، والسكري، وعوامل الخطر القلبي الوعائي الأخرى مرتفعة أيضاً، كما كانت البدانة المركزية والبدانة التي يتجاوز فيها منسب كتلة الجسم 30 كيلو غرام/ متر مربع أعلى بمقدار يعتد به إحصائياً لدى النساء (قوة احتمال أقل من 0.01). وباستثناء الهيموغلوبين وكوليسترول البروتينات الشحمية الخفيضة الكثافة، فقد كان هناك معدل انتشار لواسمات التصلب العصيدي أكثر بمقدار يعتد به إحصائياً لدى مجموعة المصابين بالمتلازمة الاستقلابية.

ABSTRACT In a cross-sectional survey conducted in 2005, we determined the prevalence metabolic syndrome (MetS) and other atherosclerotic cardiovascular disease risk factors among a sample of 342 Palestinians ≥ 20 years in East Jerusalem. Participants were interviewed and anthropometric measurements and blood testing were done. MetS was found in 115 (33.6%) participants, with no significant difference between the sexes. The prevalence of obesity, diabetes and other cardiovascular risk factors was also high, with central obesity and obesity (BMI ≥ 30 kg/m^2) being significantly higher in women (P < 0.01). With the exception of low-density lipoprotein cholesterol and haemoglobin, there was a significantly higher prevalence of atherosclerotic markers among the MetS group.

MetS et facteurs de risque cardiovasculaire chez les Palestiniens de Jérusalem-Est

RÉSUMÉ Dans une enquête transversale réalisée en 2005, nous avons déterminé la prévalence du syndrome métabolique (MetS) et d'autres facteurs de risque de maladie cardiovasculaire athérosclérotique dans un échantillon de 342 Palestiniens de Jérusalem-Est âgés de 20 ans ou plus et sélectionnés parmi les affiliés au système national d'assurance maladie. Les participants ont été interrogés et ont fait l'objet de mesures anthropométriques et d'un test sanguin. Le MetS a été détecté chez 115 participants (33,6 %), sans différence significative entre les sexes. La prévalence de l'obésité, du diabète et des autres facteurs de risque de maladie cardiovasculaire était également élevée, l'obésité abdominale et l'obésité (IMC ≥ 30 kg/ m^2) étant significativement plus élevées chez les femmes (P < 0,01). À l'exception du cholestérol LDL et de l'hémoglobine, on a constaté une prévalence significativement plus élevée de marqueurs athérosclérotiques dans le groupe de patients présentant un MetS.

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Introduction

The metabolic syndrome (MetS) refers to a clustering of specific cardiovascular risk factors whose underlying pathophysiology is thought to be related to insulin resistance [*1*]. The presence of MetS is associated with increased risk for developing atherosclerotic cardiovascular disease (ASCVD) and type 2 diabetes [*2*]. This constellation of risk factors confers a greater risk than is expected by the sum of its individual components.

Changes in lifestyle have resulted in a significant increase in morbidity and mortality secondary to chronic noncommunicable disease. Obesity is an increasingly important public health problem and is considered a major risk factor for diet-related chronic diseases including MetS, type 2 diabetes, ASCVD, hypertension, stroke and certain forms of cancer [*3*].

Jerusalem lies in the centre of the West Bank. Palestinians of East Jerusalem are a mix of Palestinians originating from cities, villages and refugee camps, but they live an urbanized lifestyle. The population of Palestinians in East Jerusalem in 2005 was 208 000. Despite the higher mortality rate among Palestinians of East Jerusalem from ASCVD compared to the Jews in West Jerusalem [*4*], there are few published data about cardiovascular disease risk factors among this population [*5–7*].

We therefore sought to assess ASCVD risk factors and determine the prevalence of MetS according to the International Diabetes Federation (IDF) criteria [*8*] among Palestinians residing in East Jerusalem.

Methods

A cross-sectional survey of people living in East Jerusalem was carried out between June and August 2005. All Palestinians living in East Jerusalem aged 20 years or older were eligible for inclusion except acutely ill subjects, pregnant women and women up to 6 months post-delivery. Sample size for a population of 208 000 was determined as 384, assuming a margin of error of 5%, with 95% confidence. As the majority of Palestinians in East Jerusalem are included in the national health insurance scheme, a target sample of 400 subjects was selected electronically from the medical records of families listed in the scheme. They were contacted by telephone and after full explanation about the study, were invited to our research clinic for interview, anthropometric measurements and blood testing. Of those contacted, 348 responded (87.0%); 6 were excluded: 3 were pregnant and 3 had haemolysed blood samples and we could not obtain second samples. Instructions for blood sampling were given over the telephone. All patients signed an informed consent form when they came to the clinic.

Data were obtained using an interviewer-administered questionnaire approved by our hospital research committee. This recorded demographic information, medical history and health-related habits of the participants. Demographic characteristics included age, sex, marital status and occupation. Information on risk factors for coronary artery disease and family history of type 2 diabetes was recorded together with an estimation of physical activity.

Participants also underwent a physical examination in which all anthropometric data were collected. Blood pressure (BP) was measured using a standard mercury sphygmomanometer (DIAGNOSTIX™952B, American Diagnostic Corporation, Hauppauge, New York) 3 times in both arms 5 minutes apart while the patient was seated for at least 5 minutes (the patient did not have caffeine-containing drinks or smoke for at least 30 minutes before the measurements were taken). We first measured BP

in both arms and took the highest reading as the first reading, in accordance with the recommendation of the *Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure* [*9*]. The third reading was taken on this arm and we took the mean of these 2 readings. Heart rate was obtained by palpating the radial artery from both sides for 1 minute. Body weight was measured in light indoor clothing without shoes; the beam balance (Beam scale model 339, Detecto, Webb City, Missouri) was placed on a hard flat surface and checked for zero balance before each measurement. Height was obtained using the height rod of the same beam scale, without shoes in an erect position. Waist circumference was measured by placing a non-stretch measuring tape around the abdomen just above the iliac crest at the end of relaxed exhalation, at least 1 hour after the last meal. Hip circumference was measured at the maximum extension of the buttocks.

Blood samples were drawn after overnight fasting for at least 12 hours for laboratory tests. The blood was centrifuged within 30 minutes of drawing and transferred in ice to a central laboratory for processing on the day of collection. An early morning spot urine sample was collected to measure microalbumin and creatinine.

Lipid profile was assessed enzymatically by the following methods: total cholesterol (TC) (CHOD-PAP, Boehringer Mannheim, Germany), high-density lipoprotein cholesterol (HDL-C) (Diagnostic kit 352-3, Sigma Diagnostics, St Louis, Missouri) and triglycerides (TG) (A-Gen kit. Abbott Laboratories, South Pasadena, California). Low-density lipoprotein cholesterol (LDL-C) level was calculated according to the Friedewald equation [*10*] for values less than 350 mg/dL of TG. Fasting plasma glucose was measured by a hexokinase method (HK-G6PD method, ABX Diagnostics Glucose HK 125, Montpellier, France). High-sensitivity C-reactive protein (hs-CRP) was measured using latex-enhanced nephelometry (NA latex CRP kit, Behring, Marburg, Germany). Unexpectedly high levels of CRP were repeated after 3 weeks to exclude any elevation due to transient causes.

Central obesity was diagnosed for waist circumference ≥ 94 cm for men and ≥ 80 cm for women according to the IDF recommendations for Mediterraneans [*8*]. Insulin resistance was defined according to IDF criteria as central obesity and hypertriglyceridaemia [*8*]. Dyslipidaemia as a risk factor for ASCVD was used to define participants who were diagnosed and treated with lipid-lowering therapy before the interview. Dysglycaemia was considered present if the participant already had diabetes, newly discovered diabetes during our screening or impaired fasting glucose (IFG), glucose ≥ 100 mg/dL.

Participants were recorded as having positive family history for diabetes or coronary artery disease if they had a first degree relative with diabetes or documented ASCVD (history of myocardial infarction or cardiac catheterization). Participants were considered physically active on a regular basis if they followed the American Heart Association recommendations for physical activity [*11*].

MetS was diagnosed according to IDF criteria [*8*]: persons with central obesity plus 2 of the following 4 factors:

- Hypertriglyceridaemia: serum TG ≥ 150 mg/dL or specific therapy for this lipid abnormality.
- Reduced HDL-C: serum HDL-C < 40 mg/dL in men, < 50 mg/dL in women or specific therapy for this lipid abnormality.

- Raised BP: systolic BP ≥ 130 mmHg or diastolic BP ≥ 85 mmHg, or treatment for previously diagnosed hypertension.
- Raised fasting plasma glucose (FPG): ≥ 100 mg/dL, or previously diagnosed type 2 diabetes.

Statistical analysis

Data were analysed using *SPSS*, version 11.0. Continuous variables were reported as mean and standard deviation (SD). The prevalences of different abnormalities were compared using either the *t*-test or chi-squared test. Statistical significance was assumed at $P < 0.05$ (2-tailed).

Results

Of the 342 participants enrolled in this study, 149 (43.5%) were men and 193 (56.4%) were women. The mean age was 38.0 (SD 10.9) years (range 20–74 years). MetS was found in 115 (33.6%) participants; prevalence was 36.8% among women and 29.5% among men ($P = 0.159$). Table 1 summarizes the participants' characteristics and the differences between men and women.

Women and men had comparable frequencies of cardiovascular risk factors (diabetes, hypertension, established ASCVD, dyslipidaemia and positive family history for ASCVD). Smoking was significantly more prevalent among men. Positive family history of diabetes was 57.6%; however, there was no statistically significant difference between men and women. Generally, women had significantly lower rates of regular physical activity than men. Although the men had higher mean waist circumference [93.5 (SD 13.2) cm] compared to the women [89.4 (SD 14.4 cm)]

Table 1 **Characteristics of the study sample by sex**

Variable	Total (*n* = 342)	Women (*n* = 193)	Men (*n* = 149)	*P*-value
Metabolic syndrome[a] [No. (%)]	115 (33.6)	71 (36.8)	44 (29.5)	0.159
Age [mean (SD)] (years)	38.0 (10.9)	37.7 (10.0)	38.4 (12.0)	0.594
Married (%)	88.0	90.7	84.6	0.08
Risk factors for CAD				
Diabetes (%)	12.6	11.9	13.4	0.677
Hypertension[b] (%)	13.2	11.4	15.4	0.273
Established CAD (%)	2.9	2.4	4.0	0.287
Dyslipidaemia (%)	8.2	9.3	6.7	0.382
Current smoker (%)	28.4	7.3	55.7	< 0.001
Family history of CAD (%)	38.0	40.4	34.9	0.297
Family history of diabetes (%)	57.6	56.5	59.1	0.632
Regular physical activity (%)	7.6	2.1	14.8	< 0.001
WC [mean (SD)] (cm)	91.2 (14.0)	89.4 (14.4)	93.5 (13.2)	0.007
Central obesity (%)	67.0	74.6	57.0	0.001
BMI [mean (SD)] (kg/m²)	29.3 (6.1)	30.4 (6.6)	27.9 (5.1)	< 0.001
Obesity (BMI ≥ 30 kg/m²) (%)	45.0	51.3	36.9	0.008
Hypertension[c] (%)	23.4	22.8	24.2	0.768

[a] *Defined according to International Diabetes Federation criteria [8].*
[b] *Already diagnosed to have hypertension with and without treatment.*
[c] *Total cases of hypertension (BP ≥ 140/90 mmHg) diagnosed in this survey.*
SD = standard deviation; CAD = coronary artery disease; WC = waist circumference; BMI = body mass index.

($P = 0.007$), central obesity was much more prevalent among women (74.6%) than men (57.0%) ($P = 0.001$). Obesity (BMI ≥ 30 kg/m^2) was also significantly higher among women ($P = 0.008$).

Laboratory and clinical data are summarized in Table 2 in the MetS participants and non-MetS participants by sex. With the exception of LDL-C and haemoglobin, there was a significantly higher prevalence of atherosclerotic markers among the MetS group. Women in the MetS group had the highest readings of SBP and heart rate among our participants. Heart rate was significantly higher among the MetS group [80, SD 10)] than those without MetS (77, SD 12) ($P = 0.002$).

The prevalence of MetS components according to sex among our sample is shown in Table 3. Low HDL-C and high BP were not significantly different between men and women, but men had a significantly higher prevalence of hypertriglyceridaemia ($P = 0.002$). The prevalence of dysglycaemia was, however, statistically significantly higher among women ($P = 0.048$) as were IFG ($P = 0.003$) and central obesity ($P = 0.001$). More than one-quarter of the participants had insulin resistance.

Discussion

We found the prevalence of MetS among Palestinians of East Jerusalem to be high, 33.6% (36.8% among women and 29.5% among men, $P = 0.159$). This is considerably higher than that found by Abdul-Rahim et al. in 2001 [*5*], who reported the prevalence among Palestinians in urban and rural areas of the West Bank to be 17%. This may be related in part to differences in the definitions used and the population studied. The lower threshold of the criteria to diagnose MetS in our study would result in an increase in the number of cases. Other important factors that could explain the difference include different lifestyles, different socioeconomic status (some people consider obesity is a sign of wealth). The apparent sedentary lifestyle of our subjects may also contribute to the higher prevalence of MetS compared to the population in the rest of the West Bank.

Palestinians of East Jerusalem live in continuous stress related to the occupation, which affects all aspects of life. We speculate that this chronic and continuous psychosocial stress may lead to chronic excess cortisol, which plays a role in the pathogenesis of MetS and may explain the high rate of MetS and its components that we found [*12*].

Arab women have a higher prevalence of MetS compared to men [*13–15*]. This also fits with the Palestinians and is related to the higher incidence of obesity among women [*6,7,16*]. In our study, the prevalence of overall obesity was 51.3% and 36.9% in women and men respectively. Furthermore, the prevalence of central obesity, which is more relevant to MetS, diabetes and the related complications, was even higher, 74.6% among women and 57.0% among men. This was the most common component of MetS among our sample.

Multiple pregnancies, high unemployment, over-eating and little physical activity, which is related to cultural and social restrictions, are associated with increased prevalence of obesity in women [*6*]. The long, loose dress worn by many women in our society, which blurs the body shape, and a loss of interest in body shape after marriage and childbirth may also play a role in the higher prevalence of obesity among women. As obesity is a key player in the development of MetS and it has a direct effect on the development of diabetes and

Table 2 **Mean (standard deviation) of atherosclerotic markers among the metabolic syndrome (MetS) participants and the non-metabolic syndrome participants**

Variable	MetS participants			Non-MetS participants			*P*-value[a]
	Total (*n* = 115)	Women (*n* = 71)	Men (*n* = 44)	Total (*n* = 227)	Women (*n* = 122)	Men (*n* = 105)	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
SBP (mmHg)	131 (19)	132 (20)	129 (17)	114 (16)	111 (15)	117 (16)	< 0.001
DBP (mmHg)	84 (12)	83 (12)	87 (11)	75 (12)	75 (11)	76 (12)	< 0.001
Heart rate (bpm)	80 (10)	82 (9)	78 (10)	77 (12)	79 (13)	74 (11)	0.002
Waist circumference (cm)	101.9 (10.3)	99.2 (10.7)	106.2 (7.9)	85.8 (12.5)	83.7 (13.1)	88.2 (11.2)	< 0.001
Waist/hip ratio	0.93 (0.08)	0.90 (0.06)	0.99 (0.05)	0.87 (0.09)	0.84 (0.10)	0.90 (0.07)	< 0.001
BMI (kg/m^2)	33.8 (4.9)	34.3 (5.7)	33.0 (3.4)	27.1 (5.4)	28.2 (6.1)	25.7 (4.1)	< 0.001
Haemoglobin (mg/dL)	13.8 (2.0)	12.7 (1.6)	15.7 (1.0)	13.9 (2.0)	12.5 (1.5)	15.5 (0.9)	1.000
WBCs (× 10^3/mL)	7.1 (1.7)	6.8 (1.7)	7.5 (1.7)	6.6 (1.8)	6.0 (1.7)	7.3 (1.8)	0.019
Glucose (mg/dL)	121 (62)	124 (62)	116 (62)	89 (23)	87 (10)	91 (32)	< 0.001
Total cholesterol (mg/dL)	188 (36)	194 (33)	178 (38)	179 (38)	177 (42)	181 (33)	0.024
LDL-cholesterol (mg/dL)	105 (33)	109 (29)	98 (37)	105 (32)	102 (35)	107 (29)	0.954
HDL-cholesterol (mg/dL)	45 (12)	48 (10)	40 (11)	51 (12)	55 (13)	47 (9)	< 0.001
Triglycerides (mg/dL)	204 (103)	198 (103)	215 (104)	118 (72)	97 (42)	144 (89)	< 0.001
CRP (mg/dL)	2.7 (2.6)	2.9 (2.9)	2.3 (2.0)	0.7 (0.7)	0.7 (0.8)	0.6 (0.6)	< 0.001
Uric acid (mg/dL)	5.8 (1.4)	5.2 (1.1)	6.8 (1.3)	5.0 (1.4)	4.3 (1.0)	5.9 (1.4)	< 0.001
ESR (mm/hr)	25 (16)	30 (17)	16 (11)	16 (14)	23 (14)	8 (7)	< 0.001
Microalb/Cr ratio (mg/g)	31 (49)	33 (49)	27 (50)	10 (21)	11 (12)	9 (28)	< 0.001
Microalbuminuria (%)	21.7	25.4	15.9	5.3	8.2	1.9	< 0.001

[a] *P-value comparing total patients of the MetS group with the non-MetS group.*

SD = standard deviation; SBP = systolic blood pressure; DBP = diastolic blood pressure; bpm = beats per minute; BMI = body mass index; WBCs = white blood cells; LDL = low-density lipoprotein; HDL = high-density lipoprotein; CRP = C-reactive protein; ESR = erythrocyte sedimentation rate; Microalb/Cr = microalbumin/creatinine.

Table 3 **Prevalence of metabolic syndrome components overall and in men and women**

Variable	Total (*n* = 342) %	Women (*n* = 193) %	Men (*n* = 149) %	*P*-value
Central obesity	67.0	74.6	57.0	0.001
Hypertriglyceridaemia	34.5	27.5	43.6	0.002
Low HDL-C	45.0	45.1	45.0	1.000
Raised blood pressure[a]	35.9	37.8	32.9	0.364
Diabetes				
Dysglycaemia	25.4	29.5	20.1	0.048
Diabetes	12.6	11.9	13.4	0.743
New onset diabetes	1.8	2.1	1.3	0.700
IFG	11.1	15.5	5.4	0.003
Insulin resistance	27.2	26.4	28.2	0.715

[a]*Blood pressure ≥ 130/85 mmHg or being treated for hypertension.*
HDL-C = high-density lipoprotein cholesterol; IFG = impaired fasting glucose.

hypertension [*17*], the 2 major components of MetS, we expect that the prevalence of MetS among obese women will increase.

Overall prevalence of dysglycaemia in our sample was 25.4%, (20.1% in men; 29.5% in women. The higher dysglycaemia rate among women may contribute to the higher MetS prevalence among women. The overall diabetes rate, including the new cases, was 14.4% with no significant difference between men and women. Cases of newly diagnosed diabetes were relatively few (1.8%). These results are comparable with other Arab countries; for instance the prevalence of diabetes in Jordanians was 13.4% [*18*], in Lebanese 15.8% [*19*] and in Kuwaitis 14.8% [*20*]. Higher prevalence rates have been noted among the Emirate population (25%) [*21*], urban Omani population (17.7%) [*22*] and Bahrainis (23%) [*23*].

The significantly higher prevalence of IFG among women was also noted by Husseini et al. and Abdul-Rahim et al. [*24,25*]. Again this could be explained by the higher rate of central obesity among women.

This high prevalence of dysglycaemia (25.4%) means that 1 person in 4 above the age of 20 years had either diabetes or prediabetes. The extremely high rate of positive family history for diabetes among our participants (57.6%) may contribute to this high prevalence. It has been shown that non-diabetics with first degree relatives with type 2 diabetes have an approximately 3-fold greater lifetime risk for developing type 2 diabetes than the general population [*26*]. Cardiovascular risk reduction is likely to be more effective if patients are treated prior to the onset of diabetes, rather than post diagnosis [*13*]. This should make diabetes management a priority health issue.

Smoking is a major cardiovascular risk factor and health problem in the World Health Organization Eastern Mediterranean Region [*27*]. There was a much higher prevalence of smoking among men in our study than women. However, this was not associated with MetS.

Only 13.2% of our participants had already been diagnosed with hypertension or were being treated for it. Using the IDF criteria, over one-third had raised BP. On the other hand, using the classic cut-off (BP ≥ 140/90 mmHg), only 23.4% of the sample had hypertension. Abdul-Rahim et al. reported a lower prevalence of hypertension

among urban men (18.9%) [*5*]. This high prevalence of hypertension and prehypertension again may be related to increased obesity in our sample. Sympathetic overactivity, which is associated with a greater risk of cardiovascular events [*28*] and is characterized by a higher resting heart rate in both men and women in the MetS group, may also be a factor.

MetS is associated with atherogenic dyslipidaemia characterized by low HDL-C, hypertriglyceridaemia and small particle LDL-C. Low HDL-C, a major independent cardiovascular risk factor, was the second most common component of MetS after central obesity among our subjects. This component of atherogenic dyslipidaemia is common among Arabs [*15*]. It was comparable between men and women, while hypertriglyceridaemia was significantly higher among men. Despite similar levels of LDL-C in both the MetS and the non-MetS groups, patients with MetS have higher levels of small particle LDL-C, which is more atherogenic [*29–31*].

An association between microalbuminuria and MetS has been established [*32*]. Among our participants, there was a striking difference between the MetS and non-MetS groups. Women with MetS had the highest prevalence of microalbuminuria due to the greater association with dysglycaemia, hypertension and central obesity compared to the other group.

There is growing evidence that MetS is associated with low-grade inflammation [*33*] characterized by elevated levels of inflammatory markers like hs-CRP, fibrinogen and white blood cells [*34–36*]. This inflammation is associated with increased risk for both ASCVD and type 2 diabetes. Our subjects with MetS had significantly higher levels of CRP than those without MetS. Women in both groups had higher levels of CRP, probably due to the higher prevalence of central obesity. White blood cell count was also significantly higher among the MetS group than those without MetS.

Our study had some limitations. The data and the blood samples were collected during work days and a fairly large number of working people did not respond to our invitation. No data were available for the non-responders so there may be a potential for bias. Another source of potential bias was the small sample size of the population studied. Education level was not included in the study to clarify the relation with MetS.

Conclusion

Our results show an alarmingly high prevalence of obesity, diabetes, MetS and other major cardiovascular risk factors among Palestinians of east Jerusalem, especially in women. A nationwide survey is needed to evaluate this prevalence further and to address the cardiovascular risk factors. National prevention projects should be started. Significant effort is needed to put in place a strategy to educate and train healthcare providers to understand MetS and implement measures to change cultural misconceptions about obesity and diabetes. Lifestyle modification, including exercise, weight loss, quitting smoking, and dietary restrictions, should be encouraged.

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