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THE PREVALENCE OF DIABETOGENIC RISK FACTORS IN NEWLY DIAGNOSED DIABETIC PATIENTS

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Abstract

Background and Aims*: The aim of this paper was the improvement of diabetes mellitus primary prevention through analysis of the prevalence of diabetogenic risk factors.* ***Materials and Methods:*** *The study group comprises 1590 newly diagnosed subjects with diabetes mellitus in a 24 month period in Ploiesti Municipal Hospital. We analyzed the prevalence in this population of some diabetogenic risk factors reported by different risk scores, including gender, age, body mass index (BMI), waist circumference (CA), physical activity at least 30 minutes a day, daily fruit and vegetable consumption, blood pressure history, family history of diabetes, etc.* ***Results****: Two-thirds of the patients declared a recent major stress. 74% had dyslipidemia at enrolment or hypolipidemic treatment. The presence of fetal macrosomia in the personal history was about 21%, from which 66% with a familial diabetes mellitus history.* ***Conclusions****: The risk factors` increased prevalence in diabetes mellitus detected in the analyzed sample population should determine an increased vigilance for an early screening of the people at risk, and to an early diagnosis of the disease.*

key words: *diabetes mellitus, risk factors, diabetes prevention.*

Background and Aims

According to recently published data, Romania is situated among the first European countries according to diabetes prevalence, with a 11.6 % prevalence of diabetes mellitus, and 18.4% prevalence of pre-diabetes, respectively [1]. The estimations for Romania regarding diabetes prevalence in 2010 were exceeded (the estimated number of diabetics was 1.469.000 [2]) when the PREDATORR study showed its results in 2013 - approximately 2.000.000 Romanian people have diabetes mellitus, detected before and during the study [1]. Besides this, it is well known that one of two patients is unaware of having diabetes [3].

Even though etiologic factors are known for a long time, the contribution of each of them in triggering diabetes mellitus cannot be exactly specified. The peak of the diabetes mellitus prevalence is at 65-74 years in the American population, and at 60-70 years in the European population. Till 50-60 years of age the prevalence of diabetes in men is higher than in

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women, but after this age the percentage is almost the same or in favor of women [4]. The highest risk of diabetes in women with a gestational diabetes history is in the first 5 years from delivery, followed in 10 years by a plateau or stationary evolution. The level of fasting blood sugar is the most powerful predictor of diabetes mellitus in women with gestational diabetes [5].

The children born with a high weight have an increased risk to develop in the future obesity and metabolic syndrome [6]. Also, children who at birth have a weight below 2500g, have a high risk to develop diabetes and obesity [6].

Regarding the risk of type 1 diabetes (T1DM), one in seven children who are descendents of a diabetic father will develop diabetes mellitus. Also, the risk is 1 in 25 if the mother was diabetic and the birth was before 25 years of age, and 1 to 100 if the child was born of a diabetic mother with age over 25 years. The risk in children born from diabetic mothers is doubled if the mother had diabetes before she was 11 years. The risk increases from 10% up to 25%, if both parents are diabetics. The association of type 2 poly-glandular autoimmune syndrome increases the descendants' risk by 50% [7]. The presence of HLA DR3 or HLA DR4 genes in white population (Caucasian) is associated with a high risk in descendants. There is a risk of 10% to brothers of a child with T1DM to develop the disease after 50 years of age. In non-identical twins, the risk is 15% and in identical twins is 40% [7].

The descendants' risk from parents with type 2 diabetes mellitus (T2DM) is 1 to 7 if the parents have the disease before 50 years of age and 1 to 13 if the disease developed after 50 years of age. If there is a single parent with diabetes, the risk in the descendents is 40-50%, but it increases till 80% if both parents are diabetics [7]. The risk of disease in non-identical twins is 10%, while in identically twins it may increase to 90%-100% [8].

The probability to develop T2DM in subjects with hypertension is 2.5 higher than in normotensive subjects [9]. It isn't clearly proved if hypertension is a risk factor in diabetes mellitus' appearance or if hypertension and pre-diabetic metabolic modifications are interdependent components within a syndrome (metabolic syndrome). The risk of diabetes mellitus is associated with the metabolic reactions of some antihypertensive drugs. From these, the effects of thiazide diuretics and beta blockers were the most discussed [9].

Lifestyle factors (regular physical exercises, daily consumption of fruits and vegetables, the lack of smoking and alcohol consumption etc.) play an important role in delaying the onset of metabolic diseases, but their contribution is not exactly specified.

Waist circumference between 94-102 cm in men and 80-88 cm in women is associated with a moderate metabolic syndrome risk, and values higher than 102 cm in men, respective 88 in women are associated with a higher risk [10-13]. Many studies have shown that an increase in weight in young adults is associated with a higher risk of diabetes and with an earlier disease's onset in comparison with older people [14,15].

The relationship between stress and diabetes is given by an increased risk of atherosclerosis, hypertension, coronary disease; excess weight due to secondary food behavior disorders; a high blood glucose value (due to an increased secretion of catecholamines and cortisone, a reduced glucose uptake and use in tissues, an increased appetite, and an increased weight with an abdominal fat predisposition) [16].

Many disorders increase the risk of diabetes mellitus by direct and indirect pathogenic mechanisms (the disturbance of insulin secretion in obesity [17] and pancreatic diseases, the presence of atherosclerosis in cardiac diseases, the metabolic syndrome associated with psycho-depressive disorders, metabolic disorders associated with thyroid hormonal disorders, insulin-resistance in steato-hepatitis), or secondary to therapy (glucocorticoids, chemotherapy, radiotherapy, thiazide diuretics and beta blockers) [18].

The aim of this study was to identify the prevalence of risk factors for diabetes in a sample of patients with newly diagnosed diabetes mellitus in Prahova County Hospital, Ploiesti.

The prevalence of the diabetes reported on June 2015 was 5% according to Diabetes County Center of Ploiesti County Emergency Hospital. The risk factors analyzed were selected taking into account their use in the majority of internationally validated risk scores for diabetes [19].

Materials and methods

We designed a cross-sectional study which included 1,590 subjects (834 women and 756 men) registered in the Diabetes Center of the Municipal Hospital Ploiesti between August 2013 and July 2015. Newly diagnosed subjects with diabetes mellitus (fasting glucose > 125 mg/dl, glycated hemoglobin > 6.5%) were included. The patients were referred to our clinic by doctors from different specialties. The subjects came from rural and urban areas of Prahova County and were aged between 21 and 93 years. The anamnesis targeted the following data: family history of diabetes mellitus (first, second and third degree relatives), history of fetal macrosomia, daily consumption of vegetables, regular physical exercise (at least 30 minutes daily of moderate intensity), relevant comorbidities, concomitant medications, dyslipidemia (elevated triglycerides ≥ 150 mg/dl, Low Density Lipoprotein cholesterol (LDLc) ≥ 100 mg/dl or High Density Lipoprotein cholesterol (HDLc) < 40 mg/dl in men and < 50 mg/dl in women), the presence of a recent major stress (physical or psychic trauma) and the maximum weight. Anthropometric data were collected (abdominal circumference, hip circumference, current weight, height) and current BMI was calculated. According to BMI patents were classified in overweight (25-29.9 kg/m^2) obesity level I (30-34.9 kg/m^2), II (35-39.9 kg/m^2), III (> 40 kg/m). According to abdominal circumference, patients were classified as follows: 80/94 cm low risk, 80-88/94-102 cm medium risk, >88/102 cm high risk. Anthropometric measurements could not be obtained for 37 patients due to immobility and they were excluded from the analysis.

We used the following risk scores: FINDRISK [20], AUSDRISK [21], QDSCORE [22], The Cambridge Diabetes Risk Score [23], Diabetes Risk Score [24], Danish Diabetes Risk Score [25] and a Romanian Risk Score [26]. The frequency of these risk factors in the above mentioned risk scores are as follows: age (7/7), gender (5/7), gestational diabetes mellitus/fetal macrosomia (1/7), ethnicity (2/7), familial history of diabetes (6/7), hyperglycemia (3/7), hypertension (7/7), smoking (7/7), vegetable consumption (3/7), physical activity (4/7), waist circumference (4/7), BMI (6/7), cardio-vascular diseases (1/7), recent corticosteroids (2/7), dyslipidemia (1/7).

Statistical analysis All statistical computations were performed using R language and environment. Normality was assessed graphically by means of quantile-quantile plots, boxplots and histograms; minor departures from normality were seen, but considering the large sample size (over 1500 observations) the central limit theorem is well applicable and small deviations from normality may be safely ignored. Means of continuous variables were compared with the t-test adjusted for unequal variances (Welch test). Proportions for categorical variables were compared with Pearson's chi-square tests. For sensitivity analysis purposes we also applied the Fisher exact test when comparing two proportions and in all cases the results were consistent (for this reason we here only provide the chi-squared test results). We also tested the influence of different variables using multiple regression models (separately for each dependent variable) to allow simultaneous adjustment for the independent variables. Model selection was based on AIC in a stepwise algorithm as implemented in the R package "MASS". Normality of residuals, homoscedasticity and influential outliers were assessed visually with a variety of diagnostic plots, mainly based on the "car" R package (q-q plots, histograms of studentized residuals, spread level, Cook's D plots); multicolinearity was evaluated by computing the variance inflation factors (vif) and autocorrelation in the residuals with the Durbin-Watson test statistic, also with the "car" package. The relative importance of each regressor was estimated with the lmg metric (the variance explained partitioned among the independent variables according to their relative importance), using the "relaimpo" R package. Comparisons between correlation coefficients were carried out by several methods implemented in the R package "cocor". The effect size for continuous variables was estimated with Hedge's g unbiased estimator, using the "effsize" R package. All inferential tests were two-sided and performed at a significance level of 0.05.

Results

Gender. The study group included 834 females (52.45%; 95% CI 49.96-54.93%) and 756 males (47.55%; 95% 45.07-50.04%). Although the difference was statistically significant (p<0.001) due to the large sample size, it seems of minor practical relevance (relative risk- RR 1.10), and it may be considered that roughly the prevalence of type 2 diabetes mellitus is similar across the sample.

Age. Age varied between 21 and 93 years, with a mean of 60.55±11.28 (95% CI 59.99 - 61.10). The mean age was somewhat higher in women (61.74±11.12, 95% CI 60.99-62.50) than in men (59.23±11.31, 95% CI 58.42-60.04) (p<0.001). Only 70 (4.34%) were 40 years or younger, and 57 (3.58%) were older than 80 years as shown in Figure 1.

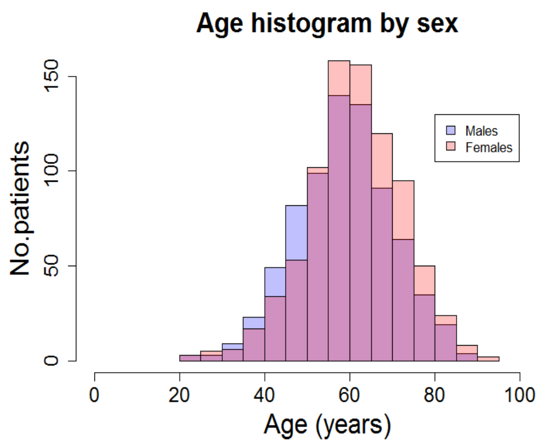

Figure 1. *Distribution of subjects according to age.*

BMI. BMI varied between 15.40 and 65.70, with 182 patients (11.38%) having values less than 25 and 135 (8.49%) values higher than 40. Mean BMI for the whole sample was 31.66±6.19 kg/m^2 (95% CI 31.35 – 31.96). In female patients mean BMI was significantly higher than in males, but the effect size was relatively small: 32.80±6.62 kg/m^2 (95% CI 32.35-33.26) versus 30.39±5.39 kg/m^2 (95% CI 30.00-30.78) (p<0.001).

BMI was significantly lower in patients performing physical exercise than in those inactive, but the difference between the two groups was rather small (mean BMI 30.89±5.28 kg/m^2 in patients performing exercise versus

32.99±7.32 kg/m2 in patients with no exercise, p<0.001). We are showing in Figure 2 the distribution of BMI in the study group by sex.

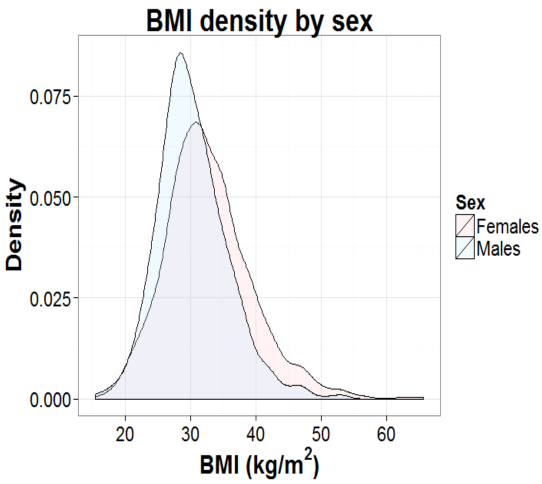

Figure 2. *BMI distribution of the study group according to sex.*

The same was true for patients consuming fruits and vegetables as compared with those with insufficient consumption of these foods (Figure 3), but the difference between the two groups was even smaller, virtually negligible (mean BMI 30.95±5.33 kg/m^2 in the former versus 32.17±6.70 kg/m^2 in the latter – 95% CI for the difference (-)1.8 – (-)0.6; Hedges's g 0.198).

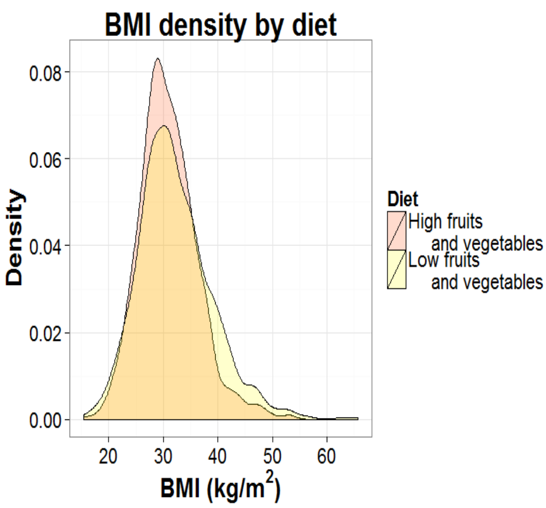

Figure 3. *BMI distribution of the study group according to diet.*

A regression model showed that BMI is influenced by sex, physical exercise, age and fruit and vegetables consumption, in decreasing order of importance (p<0.001 for each predictor). Being male and having an older age tends to decrease BMI; lack of exercise and lack of fruits and vegetables from the diet tended to increase BMI. Although statistically significant, these variables are responsible for only 10.35% of the variance seen in BMI in the data set (adjusted R squared), which suggests that other variables (not measured in our sample) have a larger impact on BMI.

Maximum BMI. In this paragraph, "maximum BMI" is used in the accepted sense used in the literature [27], of BMI based on the maximum weight a patient had in his/her history, and not in the statistical sense of outlying value (in the phrasing of the NHANES 3 study, "Up to the present time, what is the most you have ever weighed?"). Maximum BMI varied between 17.00 and 68.00, with a mean of 34.21±6.15 (95% CI 33.91 – 34.52). Similarly to the BMI, maximum BMI was significantly higher (p<0.001) in females than in males (mean 35.11±6.55; 95% CI 34.66-35.56 versus mean 33.22±5.51; 95% CI 32.83-33.62; Hedges's g 0.310, 95% CI 0.209-410) as shown in Figure 4. It was also higher in those with no physical exercise than in those performing exercise (mean 35.52±6.91 versus 33.46±5.32; p<0.001; Hedges's g 0.338; 95% CI 0.234-0.442) and in those consuming smaller amounts of fruits and vegetables (mean values 34.87±6.57 versus 33.31±5.40; p<0.001; Hedges's g 0.256; 95% CI 0.154-0.357). Sex, exercise, age and fruits and vegetable use (in decreasing order of relative importance) have all a significant influence on maximum BMI (p<0.001), but together they explained only 9.35 % of the variance seen in the dependent variable. There was a strong correlation between maximum BMI and BMI in our sample (r=0.90, 95% CI 0.89-0.91).

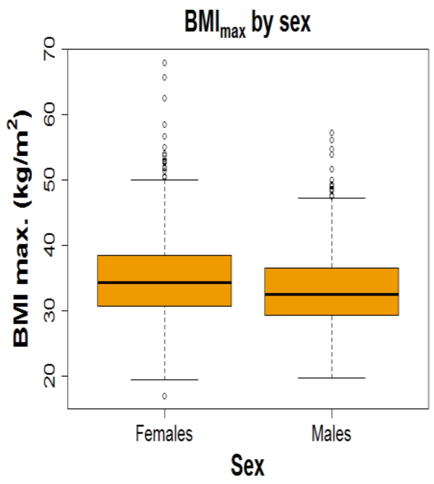

Figure 4. *BMImax of the study group according to diet.*

Waist. Waist circumference varied between 56 and 155 cm, with a mean of 104.1±12.98 cm (95% CI 103.45 – 104.75). Unlike BMI and maximum BMI, mean waist was significantly smaller in females than in males (102.47±13.09; 95%CI 101.57-103.37 versus 105.96±12.62; 95%CI 105.05-106.87; p<0.001) as depicted in Figure 5.

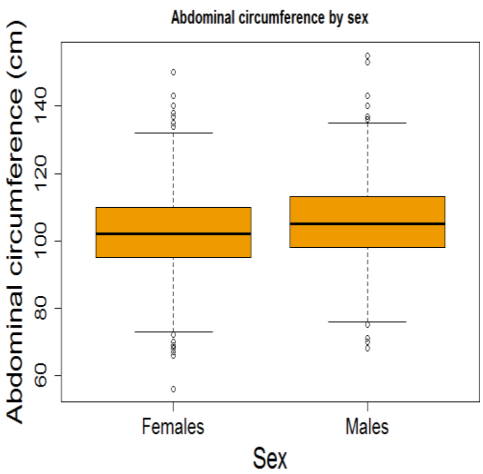

Figure 5. *Abdominal circumference in the study group according to sex.*

However, considering the known risk limits for waist in men and women [28], significantly more women were in the higher risk group than men (88.34%; 95% CI 85.89-90.43 versus 61.92%; 95% CI 58.30-65.42) (p<0.001) (Table 1).

Table 1. Distribution of males and females according to the risk group related to the waist.

Sex	Low risk (n/total) (%) (95% CI)	Medium risk (n/total) (%) (95% CI)	High risk (n/total) (%) (95% CI)
Females	30/815 (3.68%) (2.54-5.28%)	65/815 (7.98%) (6.25-10.11%)	720/815 (88.34%) (85.89-90.43%)
Males	107/738 (14.50%) (12.08-17.30%)	174/738 (23.58%) (20.59-26.84%)	457/738 (61.92%) (58.30-65.42%)

Similarly to the BMI, patients performing exercise have significantly smaller mean waist than those not doing so (102.72±11.69; 95% CI 101.99-103.45 versus 106.58±14.66; 95% CI 105.37-107.79; p<0.001; Hedges's g 0.300; 95% CI 0.196-0.404) and the same is true for those consuming higher amounts of fruits and vegetables (mean waist 102.25±11.62; 95% CI 101.36-103.14; Hedges's g 0.253; 95% CI 0.152-0.355) in comparison with those consuming lower amounts (mean waist 105.51±13.74; 95% CI 104.61-106.41, p<0.001). Modeling abdominal circumference as a function of exercise, sex, age and fruit and vegetables consumption indicated that these four variables (in decreasing order of relative importance) have a significant effect (p<0.001) on waist, although their influence is minor, as together they only explained about 5.85% of the variance seen in waist.

The models suggest that BMI is influenced more by sex than exercise, while the waist is influenced more by exercise than sex. There was a good correlation between waist and BMI (r=0.80; 95% CI 0.79-0.82) as shown in Figure 6. The correlation with maximum BMI was significantly lower (r=0.73; 95% CI 0.71-0.75) (p<0.001 for the difference between the two correlation coefficients).

Hip circumference. Hip circumference varied between 70 and 165 cm, with a mean value of 107.04±11.59 cm (95% CI 106.43-

107.59). Mean hip circumference was significantly higher in female patients (108.99±12.75 cm; 95% CI 108.11-109.86) than in males (104.90±9.73 cm; 95% CI 104.20-105.60; $p<0.01$; Hedges's g 0.358; 95% CI 0.257-0.458). Patients performing physical exercise had significantly lower mean hip circumference than those not doing so (105.59±9,83 cm; 95% CI 104.98-106.20 versus 109.58±13,80 cm; 95% CI 108.44-110.72; $p<0.001$; Hedges's g 0.349, 95% CI 0.244-0.453). Patients consuming larger amounts of fruits and vegetables also had a smaller hip circumference than those consuming smaller amounts (106.28±10,04 cm; 95% CI 105.51-107.05 versus 107.60±12,59 cm; 95% CI 106.78-108.43; $p<0.001$; Hedges's g 0.114, 95% CI 0.013-0.215), although it is evident that the influence of diet was smaller than that of exercise (negligible in terms of Hedges's g). A regression model adjusting simultaneously for these covariates and age showed that sex has the highest impact on hip circumference ($p<0.001$), followed by exercise ($p<0.001$), age ($p<0.001$) and consumption of fruits and vegetables ($p=0.035$). The model, however, explained only 7.68% of the variance seen in hip circumference in our sample. Hip circumference correlated relatively well with BMI ($r=0.88$, 95% CI 0.87-0.89), maximum BMI ($r=0.79$; 95% CI 0.77-0.80) and waist ($r=0.79$; 95% CI 0.77-0.81), but the best correlation was with BMI ($p<0.001$ against the other two). The correlation between hip circumference and BMI was not sensitive to sex, unlike the correlation between the waist and BMI, which was influenced more by the sex.

Waist to hip ratio varied between 0.72 and 1.28, with a mean and median of 0.97±0,07 (95% CI for the mean: 0.97-0.98). It was significantly smaller in women (mean 0.94±0,07; 95% CI 0.94-0.95) than in men (mean 1.01±0,06; 95% CI 1.00-1.01, $p<0.001$). The effect size is large in terms of Hedges's g: 1.038, 95% CI 0.932-1.144). No significant difference was seen between the subgroup performing habitually physical exercise and the inactive subgroup (mean value 0.97 in both groups, $p=0.877$). Rather surprisingly (considering the more limited influence of diet on BMI, waist and hip), there was a slight difference favoring the subgroup consuming higher amounts of fruits and vegetables over those with a diet poor in these foods (mean values 0.96±0,07 versus 0.98±0,07, $p<0.001$, t-student; Hedges's g 0.256, 95% CI 0.155-0.357). The regression model adjusting simultaneously for sex, exercise, diet and age indicated that the most important determinant of the waist-to-hip ratio was sex (about 94% of the variance), followed by diet (about 5% of the variance) ($p<0.001$ for both), while exercise ($p=0.615$) and age ($p=0.772$) had no significant influence on the ratio.

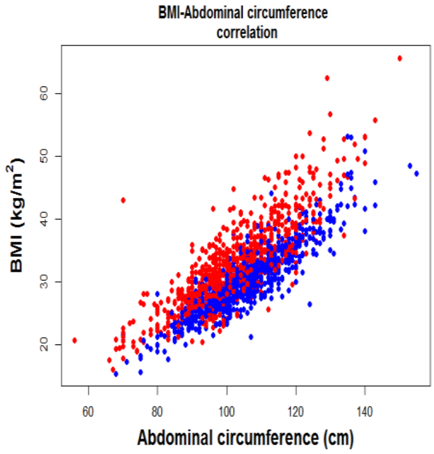

Figure 6. *Correlation between BMI and waist circumference.*

Physical exercise. 992 (62.39%; 59.95-64.77%) of the patients were performing some form of physical exercise (daily moderate physical activity, at least 30 minutes), while 598 (37.61%; 95% CI 35.23-40.05%) were inactive. The difference between the two proportions is significant ($p<0.001$). Of the 992 patients involved in physical exercise 525 (62.95%) were women and 467 (61.77%) were men ($p=0.523$).

A total of 472 (47.58%; 95% CI 44.38-50.74%) of the active patients (regularly performing physical exercise) consume fruits and vegetables, while only 197 (32.94%; 95% CI 29.21% - 36.89%) of those inactive do so ($p<0.001$).

Consumption of fruits and vegetables. A total of 669 (42.08%; 95% CI 39.64-44.55%) subjects reported to regularly consume fruits and vegetables, while the majority (57.92%; 95% CI 55.45-60.36%) denied it. Women were more prone to consume fruits and vegetables regularly in comparison to men (46.88%; 95% CI 43.46-50.34% versus 36.77%; 95% CI 33.35-40.34%; $p<0.001$).

Stress. Two thirds of the patients (1030 out of 1590; 64.78%, 95% CI 62.37-67.12%) regarded themselves as affected by stress. Proportionally, significantly more female patients were affected by stress than male patients (630 out of 834; 75.54%, 95% CI 72.45-78.39% versus 400 out of 756; 52.91%, 95% CI 49.28-56.51%). Practicing physical exercise or consuming higher amounts of fruits and vegetables did not seem to have an impact on the level of stress (64.85% of the patients practicing exercise and 65.94% of those with a more sedentary lifestyle were stressed, $p=0.945$; 63.08% of those consuming a diet richer in fruits and vegetables and 65.94% of those consuming less fruits and vegetables reported to be affected by stress, $p=0.260$).

Family history. In 904 out of 1590 patients (56.86%; 95% CI 54.38-59.30%) no family history of diabetes was reported, while in the remainder of the sample at least one first, second or third degree relative was reported to have the disease. Of the 686 who reported at least a relative with diabetes, 388 (24.40% out of the total sample; 95% CI 22.32-26.60%) had first degree relatives, 221 (13.90% out of the total sample; 95%CI 12.26-15.72%) had second degree relatives and only 78 (4.91%; 95% CI 3.92-6.11%) reported third degree relatives. The smaller proportion for the latter might at least partly reflect the limited knowledge available to the patients about more distant relatives. There was no significant difference between males and females regarding a positive family history, despite a slightly higher proportion in women with first and second degree relatives with T2DM in comparison with men (55.15% for first degree, 56.11% for second degree). Among the subgroup with BMI higher than 35, a number of 201 (out of 485; 41.44%, 95% CI 37.04-45.98%) had a family history of T2DM, while among those with a BMI equal to 35 or lower a number of 392 (out of 1198; 32.72%, 95% CI 30.08-35.47%) ($p < 0.001$). This suggests that a family history (as a proxy for genetic factors) of T2DM tends to associate with more pronounced obesity. The association seemed robust, as it persisted when limiting the analysis to the first and second degree relatives ($p<0.001$) or only to the first degree relatives ($p=0.005$).

Macrosomia. 162 of the women included in our study reported at least one macrosomic birth (birth weight ≥ 4000 g). We compared the frequency of macrosomic births among the women with a family history of T2DM and those with no history, and found a slightly higher proportion of macrosomia in the former group: 23.56% (82 out of 348; 95% CI 19.28-28.45%) versus 18.87% (80 out of 424; 95% CI 15.32-22.99%) with no statistical significance ($p=0.132$).

Comorbidities. 1064 out of 1590 patients (66.92%; 95% CI 64.54-69.22%) had one or more comorbidities. Female patients tended to have more comorbidities than males (589 out 834; 70.62%, 95% CI 67.38-73.67% versus 475 out of 756; 62.83%, 95% CI 59.26-66.27%) ($p < 0.001$). Patients practicing physical exercise had less comorbidities (602 out of 992; 60.69%, 95% CI 57.56-63.73%) than those not physically active (462 out of 598; 77.26%, 95% CI 73.64-

80.51%) (p < 0.001). As this is a cross-sectional study, the causality relationship cannot be assessed; it is reasonable to assume that exercise has a protective effect, but this difference may also reflect merely the fact that those healthier (with less comorbidities) tend to be more active than those more affected by the disease. No association was identified between a diet rich(er) in fruits and vegetables and the presence of comorbidities (451 out of 669; 67.41%, 95% CI 63.70-70.93% versus 613 out of 921; 66.56%, 95% CI 63.39-69.58%) (p=0.837). The most common comorbidities were of cardiovascular nature (454 patients), followed by articular (269 patients), endocrine (195 patients), hepatic diseases (186 patients), depression (125 patients), neoplasms (121 patients), pulmonary (108 patients), renal (69 patients), surgical (23 patients) and auto-immune diseases (14 patients). 526 patients had no comorbidities, 668 one, 306 two, 77 three, 12 four and one patient had 5 comorbidities.

High blood pressure. Overall 1325 patients (83.33%; 95% CI 81.39-85.11%) had high blood pressure while only 265 (16.67%; 14.89-18.61%) had normal blood pressure. Proportionally more women had hypertension (734 out of 831; 88.01%, 95% CI 85.56-90.10%) than men (591 out of 759; 78.17%, 95% CI 75.02-81.04%) (p < 0.001). No significant difference was seen in the prevalence of high blood pressure between the patients performing exercise and those with a more sedentary lifestyle (82.96% versus 83.95%, p=0.660), neither between those consuming higher amounts of fruits and vegetables (84.45%) and those consuming lower amounts (82.52%) (p=0.340).

Dyslipidemia. 1052 out of 1416 patients for which laboratory data were available (74.29%; 71.92-76.54%) had dyslipidemia. There was no significant difference among the sexes with regard to dyslipidemia prevalence: 73.64% in females (95% CI 70.29-76.76%; 545 out of 740 patients) versus 75.00% (95% CI 71.52-78.19%; 507 out of 676) in males (p=0.560). Exercise also seemed to have no significant influence on dyslipidemias: 74.03% (670 out of 905; 95% CI 71.02-76.84%) of the patients regularly active and 74.76% (382 out of 511; 95% CI 70.71-78.42%) of the sedentary ones had dyslipidemias (p=0.788). The same holds true for a diet rich in fruits and vegetables: 72.76% (438 out of 602; 95% CI 68.98-76.24%) of the patients with a more healthful diet and 75.43% (614 out of 814; 95% CI 72.29-78.32%) of those with a diet poorer in fruits and vegetables had dyslipidemias (p=0.282). The apparent lack of impact of exercise and diet on certain clinical parameters (such as blood pressure or dyslipidemias) might be related to a misclassification bias induced by the definition of the exercise and of diet applied in our study.

Discussions

Global estimates have indicated that males tend to have a slightly higher prevalence of DM than women for ages up to 65 years, while for older ages the prevalence is higher in females [29,30]. More recently in the United States it has been reported that in 2009, 6.6% of men had diabetes and 5.9% of women, but the disease was more common in non-Hispanic blacks [31].

One of the causes that might influence the slightly higher number of women in our study group (52.45% versus 47.55%) is the higher frequency of comorbidities in females, a phenomenon that might increase the number of medical investigations, enhancing the chance of diabetes diagnosis. The mean age was somewhat higher in women (61.74 years) than in men (59.23 years). This is in agreement with other data in the literature. This might be explained by the hormonal protection before menopause. The number of diabetic females increases after menopause because of weight gain, increased physical inactivity, etc. These factors may influence also BMI values, which were higher among women than men. However, literature data shows that the risk of diabetes in men appears in lower BMI values than in women. Physical exercise and daily consumption of vegetables were associated with significantly lower BMI, but that does not explain wholly the difference between those with a healthier lifestyle compared to others.

Women had a higher prevalence of increased waist than men (88.34% versus 61,92%), but with a much lower reported waist-to-hip ratio. Dyslipidemia occurred in 74.29% of patients, but there wasn`t a clear distinction between secondary dyslipidemia associated with lipid metabolic dysfunctions in T2DM and other forms.

The relevance of the study is represented by the fact that by acknowledging the risk factors prevalence, we can increase the vigilance in early prevention and discovery of diabetes. Our study has several limitations: This was a cross-sectional study, with its inherent limitations in making inferences (besides observing associations), restriction of the data to the time window of the study and the prevalence-incidence bias (such a study investigates prevalence, rather than incidence of cases, potentially missing patients with fatal outcomes) [32]. The fact that the study was performed in a single center and a small geographic area (one county) limits the generalization of its findings at broader (e.g. national) levels, but congruence with data from similar settings increases its strength and validity [33].

Conclusions

Physical exercise and daily consumption of fruits and vegetables have influenced positive the BMI values, waist and hip circumference.

A family history (as a proxy for genetic factors) of T2DM tends to associate with more pronounced obesity.

Stress is reported in 2/3 of patients, significantly more frequent in females and might be one of the factors that determine higher BMI in women as well as other comorbidities.

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