Research Article

Anthropometric Measurements and Obesity among Diabetic patients in EL-Minia governorate

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Abstract
Objective: The relationship between type ٢ DM, obesity and fat measures has not been well documented so far, the present study aims to determine the changes in the body composition that occurred in type ٢ DM patients and to figure out the appropriate measures of body fatness that reflect the concrete association with DM type ٢ at El-Miniagavernorate.**Subjects and Methods:**٨٠٠ subjects were divided into ٢ groups, the first is the diabetic group (٦٠٠ subject); which subdivided according to DM duration into ٣ subgroups(each ٢٠٠; ١٠٠ males and ١٠٠ females)group A (DM less than ٥years), group B (٥-١٠years) and group C (DM more than ١٠years). The second is the apparently healthy non diabetic group (control group): ٢٠٠ (١٠٠ males and ١٠٠ females); free of diabetes by one touch test.Each of the diabetic and healthy individual is subjected to the following anthropometric measurements; body weight, height, body circumferences(mid-arm, waist, hip, mid-thigh and calf), skin fold thicknesses (biceps, triceps, sub scapular, supra-iliac and calf). Random blood sugar (isassessed by single Prick Glucometer.Cut-off point of BMI (body mass index), WHR (waist to hip ratio), WHtR(waist to height ratio) and WC (waist circumference) were assessed.**Results:**the cut-off point of WC of diabetic male and female are ٨٥.٩٠ and ٩٠.١.Cut-off point of WHR of diabetic male and female are ٠.٧٨ and ٠.٨. Cut-off point of WHtR of diabetic male and female are ٤٧.٩٣ and ٤٥.٩٣ and Cut-off point of BMI of diabetic male and female are ٢٦.٤٩ and ٢٦.٥٩. WC has the largest AUC followed by WHR so, the most predictive value of DM in El-Minia gavrernorate is the WC followed by WHR then WHtR then BMI which is the least reliable predictive value of DM type ٢.**Conclusion:**obesity may be considered as a risk factor for DM type ٢, and anthropometric parameters and indices (BMI, WHR, WHtR and WC) are predictive values of DM type ٢ but measures of central obesity (WC, WHR, and WHtR) are more powerful predictors of DM type ٢ than measures of general obesity (BMI).
Key Words:DM type ٢, Obesity, anthropometric variables.

Introduction
During the last ٥٠ years, the prevalence of type ٢ DM has increased in Egypt. It has been reported that the percentage of type ٢ DM during the last decades in Egypt reached ٩٪ of the population (Herman et al., ١٩٩٥).

Obesity is a medical condition related to body mass index (BMI) of ٣٠ ($kg/m^٢$) or greater. It has been reported that the worldwide prevalence of obesity in males is ٥٠.٤٪, and in females ٦٣.١٪ (Veber et al., ٢٠٠٨). Obesity particularly abdominal obesity is an important risk factor for a broad spectrum of chronic diseases as type ٢ DM. Obesity is evaluated by many obesity anthropometric measurements and indices; such as weight, height, body circum-feren-ces, skinfold thicknesses, body mass index (BMI), waist to hip ratio (WHR) and waist to height ratio (WHtR). BMI is defined as the body weight in kilograms divided by the stature squared in meters (Weight/ $Stature^٢$) (Abdel-Malek A. et al., ١٩٨٥).

The association between type ٢DM, obesity and anthropometric measures has not been well documented so far. The present study aims to assess the changes in the body composition that occurred in type ٢ DM

patients and to figure out the appropriate measures of body fatness that reflect the concrete association with type ٢ DM at El-Miniagavernorate.

Subjects and Methods

In the present work, ٨٠٠ subjects were divided into ٢ groups, the first is the diabetic group (٦٠٠ subject, ٣٠٠ males and ٣٠٠ females); the second is the apparently healthy non diabetic group (control group): ٢٠٠ (١٠٠ males and ١٠٠ females); free of diabetes by pin prick test. Each of the diabetic and healthy individual is subjected to the following anthropometric measurements; body weight, height, body circumferences and skin fold thicknesses.

BMI,WHR and WHtR were assessed using SPSS program (version ١٣.٠). Data were expressed in the form of mean (X), standard deviation (SD) and standard error (SE). Differences between the mean values of groups (D) were tested for significance using student *t*- test.

Receiver operating curve (ROC) is used to evaluate the cutoff point of anthropometric variables; area under the curve (AUC) is determined and used to study the predictive power of various anthropometric parameters**.** Odds ratio (OR) is evaluated to assess the risk factors of type ٢ DM. Also multiple logistic regressionsis used to determine the impact of anthropometric indices on DM.

Results

Table (١): Shows the mean values and standard errors (**$\bar{X}$±SE)** of the anthropometric parameters and indices of apparently healthy and diabetic males (group A) at El-Minia.

	Apparently healthy male	**Group A diabeticmale**	
Variable	**$\bar{X}$± SE**	**$\bar{X}$± SE**	**D**
- Age	٥٥.٢±٦	٥٥±٤	٠.٢٠
- Weight	٧١.٦٣±١.٧٦	٨٦.١٠±١.٦٣	١٤.٤٧**
- Height	١٦٧±٠.٧	١٦٢±٠.٦	٥.٠٠**
Circumferences			
- Mid-arm	٢٥.٣٣±٠.٤٥	٢٩.٧٨±٠.٥٥	٤.٤٥**
- Waist	٧١.٣٥±١.٠٩	٨٧.٣١±٠.٩٥	١٥.٩٦**
- Hip	٨٩.٤٠±١.١٩	٩٩.٧٥±٠.٩٨	١٠.٣٥**
- Mid-thigh	٣٦.٣٢±٠.٦٧	٤٤.٢٠±٠.٥٤	٧.٨٨**
- Calf	٢٨.٩٧±٠.٥٢	٣٠.٢٤±٠.٣٤	١.٢٧*
Skin fold thickness			
- Biceps	١٧.٠٣±٠.٦٥	١٩.٠٩±٠.٧٧	٢.٠٦**
- Triceps	١٦.٠١±٠.٥٨	١٩.١٩±٠.٦٠	٣.١٨**
- Subscapularis	٢١.١٤±٠.٧٥	٢٦.٣٨±٠.٦٤	٥.٢٤**
- Supra-iliac	٢٣.٤٣±٠.٩٤	٢٧.٤١±١.١٢	٣.٣٨**
- Calf	١٨.٢٧±٠.٨٥	٢٨.١٥±٠.٩٩	٩.٨٨**
Anthrop. Indices			
- BMI	٢٥.٦٩±٠.٥٣	٣٢.٨٦±٠.٦٠	٧.١٧**
- WHR	٠.٨٠±٠.٠١	٠.٨٨±٠.٠١	٠.٠٨**
- WHtR	٤٨.٠٦±٠.٧٠	٥٤±٠.٦٢	٥.٩٤**

Table (٢): Shows the mean values and standard errors ($\bar{X}$±SE) of the anthropometric parameters and indices of apparently healthy and diabetic females (group A) at El-Minia.

	Apparently healthy female	Group A diabetic female	
Variable	**$\bar{X}$± SE**	**$\bar{X}$± SE**	**D**
- Age	٥٥.٤±٥	٥٤.٨±٦	٠.٦٠
- Weight	٧٢.٠٧±١.٦٠	٨٦.٤٨±١.٥١	١٤.٤١**
- Height	١٦٤±٠.٦	١٦٠±٠.٦	٤.٠٠**
Circumferences			
- Mid-arm	٢٣.٤١±٠.٦٣	٢٧.٦٢±٠.٥٥	٤.٢١**
- Waist	٧٠.٢٩±١.١٨	٨٨.٧١±٠.٩٦	١٨.٤٩**
- Hip	٩١.١٥±١.٢١	١٠١.٦٤±١.١٥	١٠.٤٩**
- Mid-thigh	٤١.٦٢±٠.٧٣	٤٦.٤٢±٠.٧٩	٤.٨**
- Calf	٣١.٥١±٠.٤٥	٣٢.٩٨±٠.٧٤	١.٢٧
Skin fold thickness			
- Biceps	١٨.٤٦±٠.٥٩	٢٤.٤٤±٠.٩١	٥.٩٨*
- Triceps	١٨.٩٠±٠.٤٩	٢٥.٣١±٠.٦٢	٦.٤١**
- Subscapularis	٢٧.٩٩±٠.٩١	٣٣.٠٩±١.١٢	٥.١٠**
- Supra-iliac	٢٩.٩٦±١.١٣	٣٤.٥٠±١.١٢	٤.٥٤**
- Calf	٣٠.٥٢±٠.٧٦	٣٤.٤٧±١.٢٩	٣.٩٥**
Anthrop. Indices			
- BMI	٢٦.٧٧±٠.٨٥	٣٣.٧٨±٠.٥٧	٧.٠١**
- WHR	٠.٧٧±٠.٠١	٠.٨٨±.٠٠٧	٠.١١**
- WHtR	٥٠.٤٥±٠.٥٧	٥٤.٧٨±٠.٦٢	٤.٣٣**

* Significant (P-value < ٠.٠٥). ** Highly significant (P-value< ٠.٠٠١).
- GroupA: DM < ٥ years. - D: difference between means.

Table (٣): Shows ANOVA test among anthropometric parameters and indices of the three studied diabetic male groups A, B and C.

	Group A	Group B	Group C	
Variable	**$\bar{X}$± SE**	**$\bar{X}$± SE**	**$\bar{X}$± SE**	**P-Value**
- Age	٥٥±٤	٥٤.٧±٧	٥٦.١±٥	٠.٦٦
- Weight	٨٦.١٠±١.٥١	٧٢.٤٤±١.٥٥	٧١.٧٧±٠.٥	٠.٠٠٠**
- Height	١٦٢±٠.٦	١٦٢±٠.٧	١٦٢±٠.٧	٠.١٠
Circumferences				
- Mid-arm	٢٩.٧٨±٠.٥٥	٢٦.٤٩±٠.٩٦	٢٣.٤٨±٠.٠٦	٠.٠٠٠**
- Waist	٨٧.٣١±٠.٩٥	٨٥.٤٧±٠.٩٥	٨٢.٨٨±٠.٧٦	٠.٠٠٠**
- Hip	٩٩.٧٥±٠.٩٨	٩٨.٦٦±٠.٩٨	٩٥.٥٠±٠.٨٠	٠.٠٠٠**
- Mid-thigh	٤٤.٢٠±٠.٥٤	٤٠.٤٥±٠.٧٠	٣٦.٥٥±٠.٦٠	٠.٠٠٠**
- Calf	٣٠.٢٤±٠.٣٤	٢٩.٩٤±٠.٤٦	٢٨.٩٥±٠.٣٩	٠.٠٧٠
Skin fold thickness				
- Biceps	١٩.٨٨±٠.٧٧	١٦.١٨±٠.٨٤	١٠.٥٥±٠.٥٧	٠.٠٠٠**
- Triceps	١٩.١٩±٠.٥٩	١٥.٥٧±٠.٦٤	١١.٣٥±٠.٤٣	٠.٠٠٠**
- Subscapularis	٢٦.٣٨±٠.٦٤	٢٣.٧٠±٠.٦٧	٢٠.١٦±٠.٦١	٠.٠٠٠**
- Supra-iliac	٢٧.٤١±١.١١	٢٢.٢٨±١.٠٢	١٨.٨٧±٠.٩٣	٠.٠٠٠**
- Calf	٢٨.١٥±٠.٩٩	٢٢.٩٤±٠.٨٩	١٧.٠٨±٠.٨٣	٠.٠٠٠**
Anthrop. Indices				
- BMI	٣٢.٨٦±٠.٦٠	٢٧.٤٤±٠.٦٤	٢٧.٣٥±٠.٥١	٠.٠٠٠**
- WHR	٠.٨٨±٠.٠١	٠.٨٧±٠.٠١	.٨٦±٠.٠٠٤	٠.٠٠٠**
- WHtR	٥٤ ±٠.٦٢	٥١.٨٤±٠.٥٨	٤٩.٥±٠.٤٥	٠.٠٠٠**

Table (٤): Shows ANOVA test among anthropometric parameters and indices of the three studied diabetic female groups A, B and C at El-Minia.

	Group A	Group B	Group C	
Variable	**X̄ ± SE**	**X̄ ± SE**	**X̄ ± SE**	**P-Value**
- Age	٥٤.٨±٦	٥٥.٣±٤	٥٥.٩±٦	٠.٥٣
- Weight	٨٦.٤٨±١.٥١	٧٨.١٦±١.٧٧	٧٢.٧٦±١.٥١	٠.٠٠٠**
- Height	١٥٩±٠.٦	١٦٠±٠.٧	١٦٠±٠.٦	٠.١٢٠
Circumferences				
- Mid-arm	٢٧.٦٢± ٠.٥٥	٢٤.٨٠±.٦٢	٢٠.٩٤±٠.٥	٠.٠٠٠**
- Waist	٨٨.٧١±٠.٩٦	٨٦.٣٥±٠.٩١	٨٣.٩٧±٠.٧٧	٠.٠٠١**
- Hip	١٠١.٦٤±١.١٥	٩٩.٦٢±١.٠١	٩٨.٨٥±٠.٩٩	٠.٠٠٠**
- Mid-thigh	٤٦.٤٢±٠.٧٩	٤١.٥٦±٠.٨١	٣٥.٩٨±٠.٦٣	٠.٠٠٠**
- Calf	٣٢.٩٨±٠.٧٤	٢٩.٧٧±٠.٤٤	٣٠.١٣±٠.٤٤	٠.٠٠٠**
Skin fold thickness				
- Biceps	٢٤.٤٤±٠.٩١	٢٥.٧٠±١.٠٦	٢٢.٩١±٠.٩٥	٠.٠٠٠**
- Triceps	٢٥.٣١±٠.٦١	٢٢.٧٢±٠.٧٨	١٩.٥٩±٠.٥٥	٠.٠٠٠**
- Subscapularis	٣٣.٠٩±١.١٢	٢٧.١٤±٠.٨٣	٢٠.٧١±٠.٦٠	٠.٠٠٠**
- Supra-iliac	٣٤.٥٠±١.١٢	٢٦.١٠±١.٠٧	٢١.٦٢±٠.٧٠	٠.٠٠٠**
- Calf	٣٤.٤٧±١.٢٩	٢٦.٧٣±١.٨١	٢٠.٢٤±٠.٦٠	٠.٠٠٠**
Anthrop. Indices				
- BMI	٣٣.٢١±٠.٥٧	٣٠.٥٣±٠.٦٤	٢٨.٤٢±٠.٥٨	٠.٠٠٠**
- WHR	٠.٨٨±.٠٠٧	٠.٨٧±.٠٠٤	٠.٨٥±.٠٠٤	٠.٠٠٠**
- WHtR	٥٤.٧٨±٠.٦٢	٥٤.٢٠±٠.٥٨	٥١.٩٣±٠.٤٥	٠.٠٠٠**

* Significant (P-value < ٠.٠٥). ** Highly significant (P-value < ٠.٠٠١).
- Group A: DM (<٥ Y). - Group B: DM (٥-١٠ Y). - Group C: DM (١٠-١٥ Y).

Table (٥): Shows the mean values and standard errors (**X̄ ±SE)** of anthropometric parameters and indices of apparently healthy male and female subjects at El-Minia.

	Healthy male	Healthy female	
Variable	**X̄ ± SE**	**X̄ ± SE**	**D**
- Age	٥٥.٢±٦	٥٥.٤±٥	٠.٧٨٦
- Weight	٧١.٦٣±١.٧٦	٧٢.٠٧±١.٦٠	٠.٤٤
- Height	١٦٧±٠.٧	١٦٤±٠.٧	٣.٠٠**
Circumferences			
- Mid-arm	٢٥.٣٣±٠.٤٥	٢٣.٤١±٠.٦٣	١.٩٢*
- Waist	٧١.٣٥±١.٠٩	٧٠.٢٩±١.١٨	١.٠٦
- Hip	٨٩.٤٠±١.١٩	٩١.١٥±١.٢١	١.٧٥
- Mid-thigh	٣٦.٣٢±٠.٦٧	٤١.٦٢±٠.٧٣	٥.٣٠**
- Calf	٢٨.٩٧±٠.٥٢	٣١.٥١±٠.٤٥	٢.٥٤
Skin fold thickness			
- Biceps	١٧.٠٣±٠.٦٥	١٨.٤٦±٠.٥٩	١.٤٣
- Triceps	١٦.٠١±٠.٥٨	١٨.٩٠±٠.٤٩	٢.٨٩**
- Subscapularis	٢١.١٤±٠.٧٥	٢٧.٥٥±٠.٩١	٦.٤١**
- Supra-iliac	٢٣.٤٣±٠.٩٤	٢٩.٩٦±١.١٣	٦.٥٣**
- Calf	١٨.٢٧±٠.٨٥	٣٠.٥٢±٠.٧٦	١٢.٢٥**
Anthrop. Indices			
- BMI	٢٥.٦٩±٠.٥٣	٢٦.٧٧±٠.٠٥	١.٠٨
- WHR	٠.٨٠±٠.٠١	٠.٧٧±٠.٠١	٠.٠٣
- WHtR	٤٨.٠٦±٠.٧٠	٥٠.٤٥±٠.٥٧	٢.٣٩**

Table (٦): Shows the mean values and standard errors **($\bar{X}$±SE)** of anthropometric parameters and indices of diabetic male and female patients (group A) at El-Minia.

	Group A diabetic male	**Group A diabetic female**	
Variable	**$\bar{X}$± SE**	**$\bar{X}$± SE**	**D**
- Age	٥٥±٤	٥٤.٨±٦	٠.٨٠
- Weight	٨٦.٠٩±١.٦٣	٨٦.٤٨±١.٥١	٠.٣٩
- Height	١٦٢±٠.٦	١٥٩±٠.٦	٢*
Circumferences			
- Mid-arm	٢٩.٧٨±٠.٥٥	٢٧.٦٢±٠.٥٥	٢.٦١*
- Waist	٨٧.٣١±٠.٩٥	٨٨.٧١±٠.٩٦	١.٤٠
- Hip	٩٩.٧٥±٠.٩٨	١٠١.٦٤±١.١٥	١.٨٩*
- Mid-thigh	٤٤.٢٠±٠.٥٤	٤٦.٤٢±٠.٧٩	٢.٢٢*
- Calf	٣٠.٢٤±٠.٣٤	٣٢.٩٨±٠.٧٤	٢.٧٤**
Skin fold thickness			
- Biceps	١٩.٨٨±٠.٧٧	٢٤.٤٤±٠.٩١	٤.٥٦**
- Triceps	١٩.١٩±٠.٦	٢٥.٣١±٠.٦١٢	٦.١٢**
- Subscapularis	٢٦.٣٨±٠.٦٤	٣٣.٠٩±١.١٢	٦.٧١**
- Supra-iliac	٢٧.٤١±١.١٢	٣٤.٥٠±١.١٢	٧.٠٩**
- Calf	٢٨.١٥±٠.٩٩	٣٤.٤٧±١.٢٩	٦.٣٢**
Anthrop. Indices			
- BMI	٣٢.٨٦±٠.٦٠	٣٣.٣١±٠.٥٧	٠.٤٥
- WHR	٠.٨٨ ± ٠.٠١	٠.٨٨±٠.٠١	٠
- WHtR	٥٤ ±٠.٦٢	٥٤.٧٨±٠.٦٢	٠.٧٨

Fig. (١) and (٢): Shows Receiver operating characteristics (ROC) curve analysis of BMI, WHR, WHtR and WC in diabetic males and females.

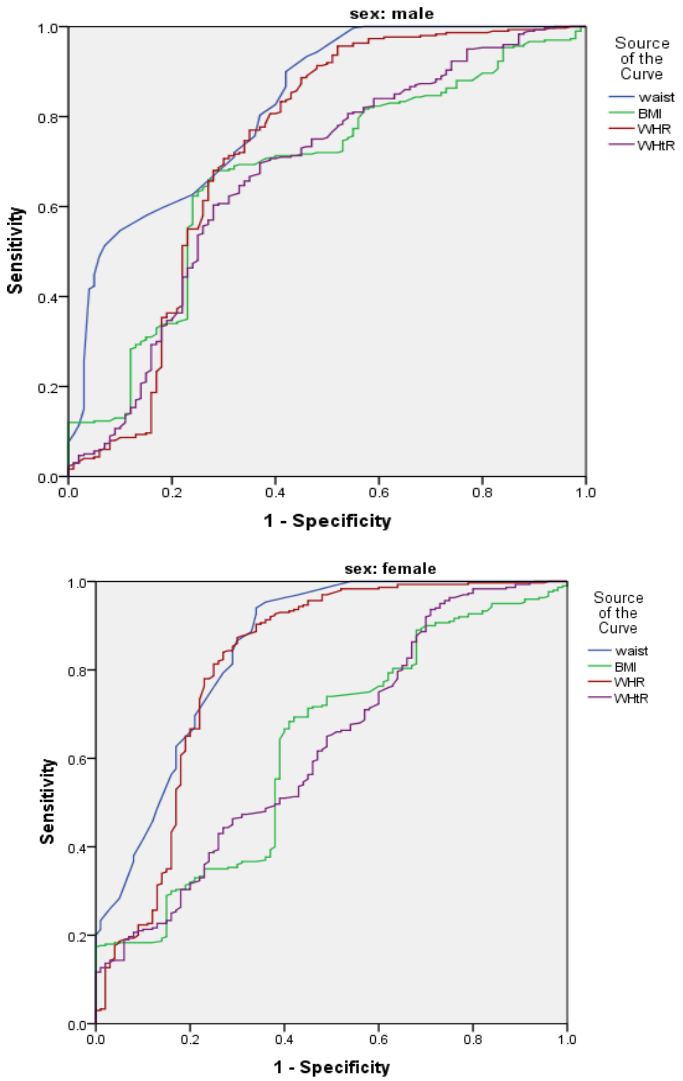

Fig. ١ and ٢ show that; WC has the largest AUC followed by WHR so, the most predictive value of DM in El-Minia gavrernorate is the WC followed by WHR then WHtR then BMI which is the least reliable predictive value of DM type ٢. It is clear also that anthropometric mrasurements of abdominal (central) obesity (WC, WHR and WHtR) are more efficient in prediction of DM than that of overall (general) obesity (BMI).

In males	Cutoff value	AUC	Sensitivity	Specificity	PPV	NPV	P value
BMI	>٢٦.٤٩	٠.٦٧٥	٦٨	٧٢	٨٧.٩	٤٢.٩	<٠.٠٠١*
WHR	>٠.٧٨	٠.٧٣٠	٩٥.٦٧	٤٨	٨٤.٧	٧٨.٧	<٠.٠٠١*
WHtR	>٤٧.٩٣	٠.٦٧١	٦٩.٦٧	٦٣	٨٥	٤٠.٩	<٠.٠٠١*
WC	>٨٥.٩	٠.٨٢٤	٩٩.٦٧	٤٥	٨٤.٥	٩٧.٨	<٠.٠٠١*

In females	Cutoff value	AUC	Sensitivity	Specificity	PPV	NPV	P value
BMI	> ٢٦.٥٩	٠.٦٢٨	٦٩.٣٣	٥٨	٨٣.٢	٣٨.٧	<٠.٠٠١*
WHR	>٠.٨	٠.٨١٤	٨٧.٣٣	٧٠	٨٩.٧	٦٤.٨	<٠.٠٠١*
WHtR	> ٤٥.٩٣	٠.٦٢٨	٩٣.٦٧	٢٩	٧٩.٨	٦٠.٤	<٠.٠٠١*
WC	> ٩٠.١	٠.٨٥٠	٩٥.٣٣	٦٤	٨٨.٨	٨٢.١	< ٠.٠٠١*

- AUC: area under the curve. - PPV: positive predictive value
- NPV: negative predictive value. * Significant: AUC > ٠.٥.

Table (٧): Shows multiple logistic regression analysis of BMI, WHR, WHtR and WC in males.

In males	Control (n=١٠٠)	Diabetics (n=٣٠٠)	P value	OR (٩٥ % CI)	P value	AOR (٩٥ % CI)	P value
BMI							
≤ ٢٦.٤٩	٧٢ (٧٢٪)	٩٦ (٣٢٪)	< ٠.٠٠١*	٥.٤٦ (٣.٣٢-٩)	< ٠.٠٠١*	١.٨ (٠.٧٧-٤.١٨)	٠.١٧٥
> ٢٦.٤٩	٢٨ (٢٨٪)	٢٠٤ (٦٨٪)					
WHR							
≤٠.٧٨	٥٨ (٤٨٪)	١٣ (٤.٣٪)	<٠.٠٠١*	٢٠.٣٨ (١٠.٣٢-٤٠.٢٤)	< ٠.٠٠١*	٨.٦٨ (٣.٦٩-٢٠.٥)	< ٠.٠٠١*
>٠.٧٨	٤٢ (٥٢٪)	٢٨٧ (٩٥.٧٪)					
WHtR							
≤ ٤٧.٩٣	٦٣ (٦٣٪)	٩١ (٣٠.٠٪)	<٠.٠٠١*	٣.٩١ (٢.٤٣-٦.٢٩)	< ٠.٠٠١*	١.٨٣ (٠.٨-٤.٢٧)	٠.١٦٠
> ٤٧.٩٣	٣٧ (٣٧٪)	٢٠٩ (٦٩.٧٪)					
Waist							
≤ ٩٠.١	٦٠ (٦٠٪)	١ (٠.٣٪)	<٠.٠٠١*	٢٤٤.٦ (٣٣.٠٣-١٨١٢)	< ٠.٠٠١*	٥٦.٩ (٧.٢-٤٤٦.٥)	< ٠.٠٠١*
> ٩٠.١	٤٠ (٤٠٪)	٢٩٩ (٩٩.٧٪)					

Table (٨): Shows multiple logistic regression analysis of BMI, WHR, WHtR and WC in females.

In females	Control (n=١٠٠)	Diabetics (n=٣٠٠)	P value	OR (٩٥ % CI)	P value	AOR (٩٥ % CI)	P value
BMI ≤٢٦.٥٩ >٢٦.٥٩	٥٨ (٥٨٪) ٤٢ (٤٢٪)	٩٢ (٣٠.٧٪) ٢٠٨ (٦٩.٣٪)	< ٠.٠٠١*	٣.١٢ (١.٩٥-٤.٩٧)	< ٠.٠٠١*	١.٣ (٠.٥٨-٢.٧٤)	٠.٥٦٠
WHR ≤٠. ٨ >٠.٨	٧٠ (٧٠٪) ٣٠ (٣٠٪)	٣٨ (١٢.٧٪) ٢٦٢ (٨٧.٣٪)	<٠.٠٠١*	١٦.٠٩ (٩.١٣-٢٧.٧٩)	< ٠.٠٠١*	٦.٠ (٣.٠٦-١١.٨٦)	< ٠.٠٠١*
WHtR ≤٤٥.٩٣ >٤٥.٩٣	٧٢(٧٢٪) ٢٨ (٢٨٪)	١٩ (٦.٣٪) ٢٨١ (٩٣.٧٪)	<٠.٠٠١*	٥.٧٥ (٣.٠٤-١٠.٨٨)	< ٠.٠٠١*	٠.٠٩ (٠.٨٦-١.٤٦)	٠.١٥٠
Waist ≤٨٥.٩ >٨٥.٩	٦٤ (٦٤٪) ٣٦ (٣٦٪)	١٤ (٤.٧٪) ٢٨٦ (٩٥.٣٪)	<٠.٠٠١*	٣٦.٣ (١٨.٥-٧١.٣)	< ٠.٠٠١*	٢٩.٨٧ (٨.١-١١٠.٧)	< ٠.٠٠١*

- OR: odds ratio. - AOR: adjusted odds ratio
* Significant: P-value < ٠.٠٠١. - CI (Confidence interval).

Table ٧ and ٨, showthat the odds ratio of WC is the highest followed by WHR, so WC is the most significant relative risk factor of DM type ٢ in males and females. In AOR, WC is an adjusted risk factor of type ٢DM in males and females but WHtR is not considered as an adjusted risk factor as P-value = ٠.١٥٠.

Discussion

The global prevalence of DM in the year ٢٠١٠ among adults had been estimated to be ٦.٤٪. There is no accurate figure for prevalence of DM in Egypt, the crude prevalence of diabetes mellitus in Egypt in ٢٠٠٨, was calculated to be ٤.٠٧٪. Cairo governorate had a prevalence of ٤.٩٪, while El-Minia governorate had a preva-lence of ٤.١٪ (Nagwa A. and Ghada A., ٢٠١٠). The possible risk factors of DM in Egypt includes rapid socioeconomic change, urbanization, sedentary lifestyle, and prevalence of overweight and obesity (Abolfotouh et al., ٢٠٠٨).

In the present study, healthy and diabetic females are heavier than healthy and diabetic males. This may be due to regional differences in adipocyte metabolism and lipoprotein lipase activity as lipolysis are more pronounced in women than in men (Rebuffe et al., ١٩٨٥).Also, it is clear that the diabetic male and female subjects are shorter than healthy individuals, this in accordance with results documented byLawlor et al., (٢٠٠٢), this association are not understood. It may be due to osteo-porosis associated with diabetes, which results in reduced stature due to vertebral collapse (Isaia et al., ١٩٨٧).

Body mass index (BMI) of diabetic persons is bigger than that of healthy individuals, so obesity may lead to development of type ٢ DM and this is in accordance with the results reported by Kumar et al., (٢٠١٣).The role of obesity in the development of DM may be through free fatty acid (FFA) which leads to secretion of adipokines. These adipokines cause insulin resistance,Robertet al., (٢٠١١). In the present study, the mean value of BMI of female is bigger than that of male in the healthy and diabetic groups. These results are similar to the results reported byAschner et al., (٢٠٠٩) who found that obesity prevalence in males is ٧٠٪, and ٧٦٪ in females.Adult men and women differ in their fat distribution.Fat tend to accumulate in the abdominal area so obese men are "apple-shaped" with increa-sing waist circumference, however; obese females tend to be "pear- shaped" as females has big pelvis designed for

childbirth. Regional localization of body fat is considered a secondary sex characteristic (Blouin K et al., ٢٠٠٨).

In the present work, the body circumferences ofdiabetic male and female group A are bigger than those of healthy ones and this is in accordance with Sosenko et al., (١٩٩٣) who reported that, obesity and excess body fat are associated with insulin resistance and places people at higher risk for developing insulin resistance. The association between obesity and insulin resistance is due to increased release of FFA and abnormalities in adipokine secretion. Body circumferences of healthy and diabetic females are bigger than that of healthy and diabetic male subjects. This may be due to increased frequency of obesity and body fatness in females than in males (Eun et al., ٢٠٠١).In the present study, the optimal cut-off point of WC of diabetic male and female are ٨٥.٩٠ and ٩٠.١ respectively, these values are smaller than WC cut-off points reported by Łopatyński et al., (٢٠٠٣) which was ٩٧ for women and ٩٩ for men but; larger than WC cut-off point that documented by He et al., (٢٠١٢) which was ٨٤ in men and ٨٠ in women. It is observed that, SFT at all sites measured in diabetic male and female patients group A are thicker than those of apparently healthy male and female individuals, and since ٥٠٪ of the body fat is present in the subcutaneous tissue layers so diabetic patients are more obese and have subcutaneous fat more than healthy ones. This is in harmony with the results of Robert et al., ٢٠١١.

The optimal cut-off point of BMI of diabetic male and female subjects (٢٦.٤٩ and ٢٦.٥٩) are larger than optimal cut-off point of BMI of diabetic Chinese male and female which were (٢٤ and ٢٤) as documented by Feng et al., (٢٠١٢), but; it is smaller than that of diabetic jordanianmen and women (٢٨.٤ and ٣٠.٣) which was reported by Al-Odat et al., (٢٠١٢). The optimal cut-off point of WHR of diabetic male and female subjects in the present study(٠.٧٨ and ٠.٨٠)are larger than that of diabetic Chinese male and female which were (٠.٦٦ and ٠.٦٥) as reported by Hu et al. (٢٠٠٧). But; they are smaller than WHR optimal cut-off point of diabetic jordanian men and women (٠.٨٩ and ٠.٨٤) which was found by Al-Odat et al., (٢٠١٢).

The optimal cut-off point of WHtR of diabetic male and female subjects in the present study (٤٧.٩ and ٤٥.٩) are smaller than that of diabetic male and female subjects in Iraq (٥٢ and ٥٦) which were reported by Mansour and Al-Jazairi (٢٠٠٧)a.

Area under the receiver operating characteristics curve (AUC) of BMI, WHR, WHtR and WC of diabetic male subjects are ٠.٦٢٨, ٠.٨١٤, ٠.٦٢٨ and ٠.٨٥٠ respectively and of diabetic female subjects are ٠.٦٢٨, ٠.٨١٤, ٠.٦٢٨ and ٠.٨٥٠ respectively. As AUC (must be > ٠.٥) of the four anthropometric measures is statistically significant so they may be strongly relate to and predict the incidence of type ٢ DM in Egypt. AUC of WC in males is the highest followed by WHR then WHtR then BMI. WC could statistically predict type ٢ DM in Egypt more than other anthropometric measures. These results are consistent with the results reported by Kai et al., (٢٠١١) in China. However, AUC of the present study is disagree with results reported by Nyamdorj et al., (٢٠٠٩), who found that BMI strongly relate to and predict the incidence of type ٢ DM.

As (P- value < ٠.٠٠١) so the four anthropometric variables are considered as independent risk factors for DM type ٢ in Egypt in the following order (WC, WHR, WHtR and BMI). These results are in agreement with the results reported by Vazquez et al., (٢٠٠٧).

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