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Original article

Prevelance Of Prediabetes Among Rhematoid Arthritis Patients

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Abstract :

Background : Rheumatoid Arthritis is a known risk factors for type 2 diabetes mellitus (T2DM). However, the relationship Rheumatoid Arthritis and prediabetes is inconclusive. **Objective:** to explore the prevalence of prediabetes among rheumatoid arthritis in Egyptian population. **Methods:** Fasting blood Sugar , 2 hour postprandial , HbA1c, Insulin level and HOMA-IR was measured in a group of 60 individuals , 30 patients with rheumatoid arthritis and 30 healthy controls to determine incidence of prediabetes among them . Patients were also exposed to careful history taking with special stress on history of any other autoimmune diseases or other comorbidities ,Height and weight were measured , Waist circumference (WC) was measured. , searched for Insulin resistance signs as acanthosis nigricans .**Results:** Our results showed that there was an association between Rheumatoid arthritis and prediabetes. The study illustrated that there was a statistical significant difference higher percentage of pre-diabetic

patients among case group 29.2% versus 4.2% in control group with p-value 0.04 suggesting that Rheumatoid arthritis has a role as a risk factor for developing both prediabetes and DM . **Conclusion:** Rheumatoid arthritis may be a risk factor for developing prediabetes in Egyptian patients.

1. Introduction :

Rheumatoid arthritis (RA) is a chronic, symmetrical, inflammatory autoimmune disease that initially affects small joints, progressing to larger joints, and eventually the skin, eyes, heart, kidneys, and lungs. Often, the bone and cartilage of joints are destroyed, and tendons and ligaments weaken .[1] With a greater understanding of the course of diabetes throughout time, the term "prediabetes" first appeared in the late 1970s. The phrase was used to denote the first detectable stage of glucose dysregulation, which was shown to be characterised by plasma glucose levels that fell somewhere between those of normal glucose tolerance and diabetes. [2]

Impaired glucose tolerance (IGT), which is determined using 2-hour post-glucose load readings on an oral glucose tolerance test ranging from 140 mg/dl to 199 mg/dl, was first referred to as prediabetes in 1979 by the National Diabetes Data Group.The American Diabetes Association (ADA) and the World Health Organization (WHO) have adopted the IGT classification. [2] The ADA and WHO then added an extra category of impaired fasting glycemia (IFG) based on fasting blood glucose (FBG) readings of 110–125 mg/dl in 1997 and 1998, respectively. The IFG diagnostic criteria were updated by the ADA in 2003, expanding the FBG range from 110 to 125 mg/dl to 100 to 125 mg/dl. The American Diabetes Association (ADA) first suggested using hemoglobin A1C (HbA1C) to diagnose diabetes in 2010 along with a new hemoglobin A1C (HbA1C)-based definition of prediabetes. [3]

Nonetheless, the link between diabetes and RA has been known for a long time. It was first theorized many years ago and was mostly attributed to the diabetogenic action of corticosteroid therapy, while more recent research indicates a "neutral" effect. There are now 2 primary explanations that have been put

forth: on the one hand, RA patients appear to have a favored clustering of cardiovascular risk factors (such as obesity, alcohol consumption, or smoking), and on the other, chronic high-grade inflammation has a well-established diabetogenic effect. [4]

Emerging data points to inflammation as a primary cause for this increased risk, independent of corticosteroids and traditional cardiovascular risk factors. This is linked to the disruption of insulin signaling caused by inflammatory cytokines, particularly TNF- and IL-6-32, and the subsequent emergence of insulin resistance. Many studies showed a strong correlation between visceral obesity and inflammation as well as a higher incidence of insulin resistance in RA. [5]

2. Material and Methods :

2.1. Patients : This case-control study was conducted on 60 subjects , 30 Rheumatoid arthritis patients and 30 healthy controls . The patients were recruited from the Immunology Outpatient Clinic at Beni-Suef University Hospitals in upper Egypt during the period from December 2021 to February 2023. This study was approved by the local research ethical committee in Beni-Suef university Hospital (Approval No : FMBSUREC/10102021/Mohmaed). The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (Faculty of Medicine, Beni-Suef University) and with the Helsinki Declaration of 1975, as revised in 1983. All participants provided informed consent to participate in this study. Inclusion of the patients was based on the diagnosis of Rheumatoid arthritis according to the 2010 ACR/EULAR classification criteria for RA. , and both cases and controls were age and sex matched. Overweight or obese (BMI ≥25 kg/m2) patients , patients with family history of diabetes , past history of other auto immune diseases or other major comorbidities

(chronic kidney disease , liver cirrhosis) , history of gestational diabetes mellitus , women with polycystic ovary syndrome , patients with history of use of systemic glucocorticoids were excluded from the study . All the patients were subjected to thorough history taking with special stress on history of any other autoimmune diseases or other comorbidities , Drug history with special stress on use of systemic glucocorticoids .Patients were also subjected to proper clinical examination including height and weight measurement with patients wearing light clothing and no shoes,

waist circumference (WC) was assessed with a flexible tape at midpoint between the lowest rib margin and the iliac crest. Blood pressure was measured ,Insulin resistance signs as acanthosis nigricans were searched for . Biochemical analysis was done for the measurement of Fasting blood sugar (FBS) , 2 Hour post prandial sugar (2hrpp) , HbA1c , Fasting insulin level , HOMA IR :fasting insulin (microU/L) x fasting glucose (nmol/L)/22.5, Serum albumin , Serum creat. , Lipid profile .

2.2 Statistical Analysis :

Data collected and coded to facilitate data manipulation and double entered into Microsoft Access and data analysis performed using the Statistical Package of Social Science (SPSS) software version 22 in windows 7 (SPSS Inc., Chicago, IL, USA).Simple descriptive analysis in the form of numbers and percentages of qualitative data, and arithmetic means as central tendency measurement, standard deviations as a measure of dispersion of quantitative parametric data.Quantitative data included in the study first tested for normality by One-Sample Kolmogorov-Smirnov test in each study group then inferential statistic tests selected.

For quantitative parametric data: Independent samples t test was used to compare quantitative measures between two independent groups

For quantitative non parametric data : The Mann-Whitney test used to compare two independent groups.

For qualitative data : Chi square test used to compare between two of more than two qualitative groups.

The significance of the results was assessed in the form of P-value that was differentiated into: Non-significant when P-value > 0.05, Significant when P-value ≤ 0.05 and Highly significant when P-value ≤ 0.001

3. Results :

6 cases were excluded from patients as they were diagnosed with Diabetes Mellitus and 6 were excluded also from control group to make the two groups equal to each other .

Table (1): Comparisons of demographic characteristics in different study groups.

Variables	Cases (N=24)		Control (N=24)		P-value	Sig.
Age (years)						
Mean ± SD	35.6±13.9		34±8.6		0.6	NS
Sex						
Male	8	33.3%	8	33.3%	0.9	NS

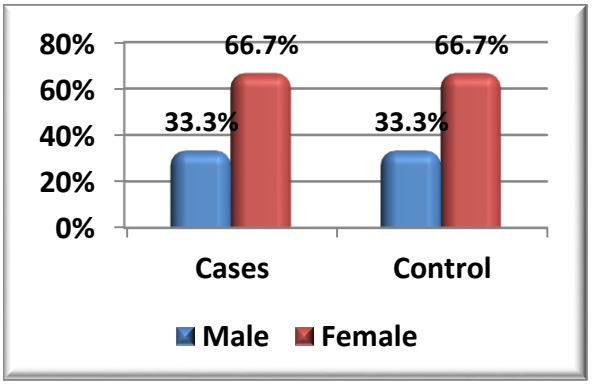

Figure (1):

The table illustrated that there was no statistical significant difference with p-value >0.05 between cases and controls as regards age and sex distribution.

Table (2): Comparisons of anthropometric measure in different study groups.

Variables	Cases (N=24)		Control (N=24)		P-value	Sig.
	Mean	SD	Mean	SD		
Height (cm)	1.59	0.08	1.61	0.04	0.3	NS
Weight (kg)	60.5	6.7	60.8	3.3	0.8	NS
BMI (kg/m^2)	23.7	1.3	23.5	0.95	0.3	NS
Waist circumference(cm)	79.9	4.3	81.1	2.7	0.2	NS

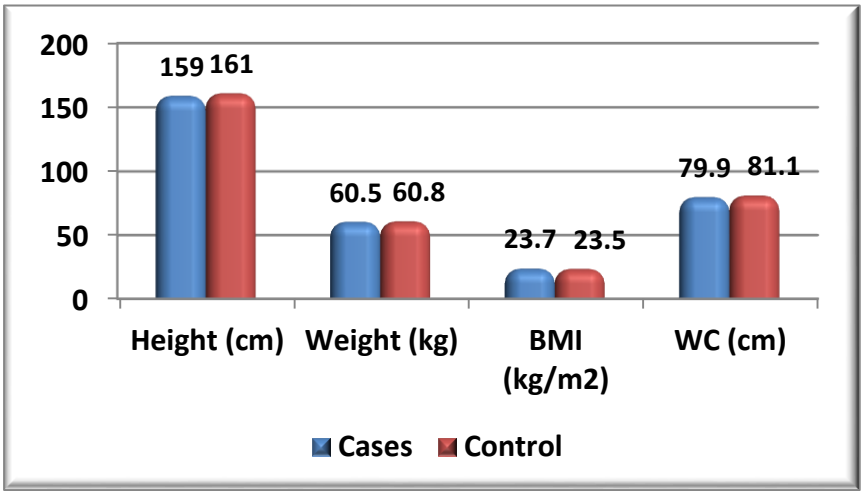

Figure (2):

The table illustrated that there was no statistical significant difference with p-value >0.05 between cases and controls as regards anthropometric measures (height, weight, waist circumference, and BMI).

Table (3): Comparisons of Blood pressure in different study groups.

Blood pressure	Cases (N=24)		Control (N=24)		P-value	Sig.
	Mean	SD	Mean	SD		
Systolic	114.6	7.8	115.8	6.5	0.6	NS
Diastolic	75.4	5.1	73.8	4.9	0.3	NS

The table illustrated that there was no statistical significant difference with p-value >0.05 between cases and controls as regards systolic and diastolic blood pressure.

Table (4): Comparisons of glucose profile tests in different study groups.

Variables	Cases (N=24)		Control (N=24)		P-value	Sig.
	Mean	SD	Mean	SD		
FBS	91.3	20.4	84.3	9.2	0.1	NS
2hpp	127.9	14.7	127.3	8	0.8	NS
HbA1c%	5.5	0.44	5.4	0.16	0.2	NS

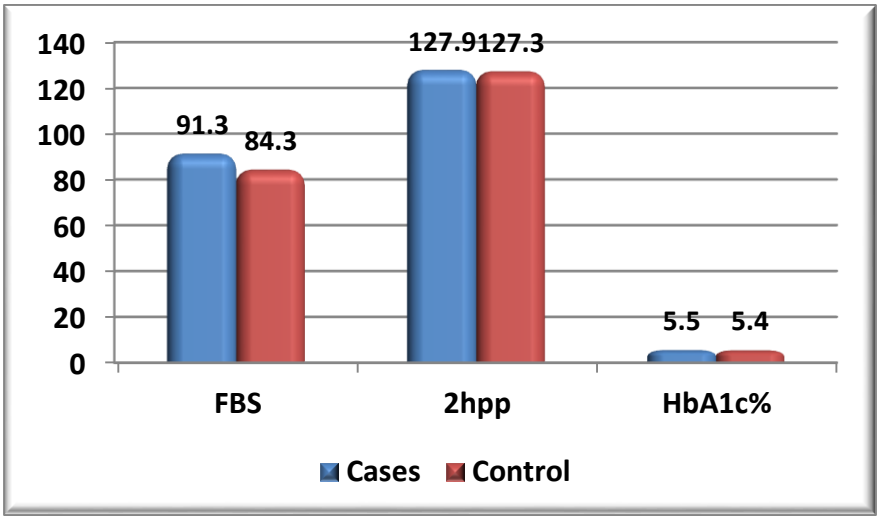

Figure (3):

The table illustrated that there was nostatistical significant difference with p-value >0.05 between cases and controls as regards fasting blood sugar, postprandial glucose level and level of HbA1c.

Table (5): Comparisons of insulin profile tests in different study groups.

Variables	Cases (N=24)		Control (N=24)		P-value	Sig.
	Median	Range	Median	Range		
Insulin level	8.6	1.4-51.1	8.1	0.4-30.4	0.5	NS
HOMA -IR	1.75	0.22-12.6	1.66	0.08-6	0.3	NS

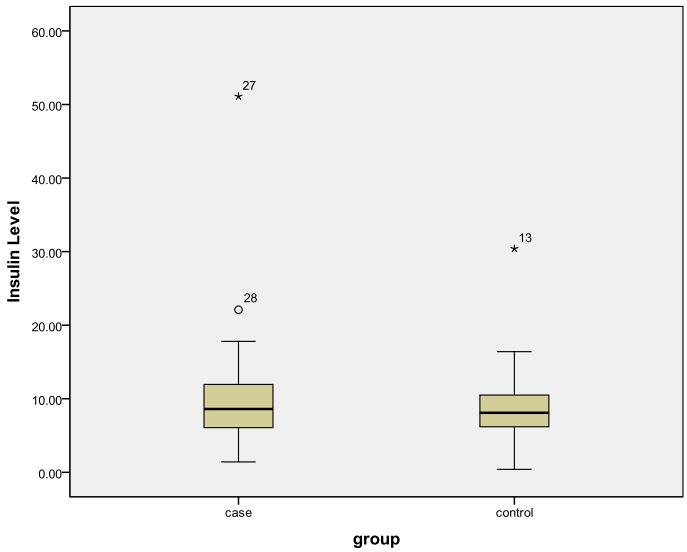

Figure (4):

The table illustrated that there was no statistical significant difference with p-value >0.05 between cases and controls as regards levels of insulin and HOMA-IR.

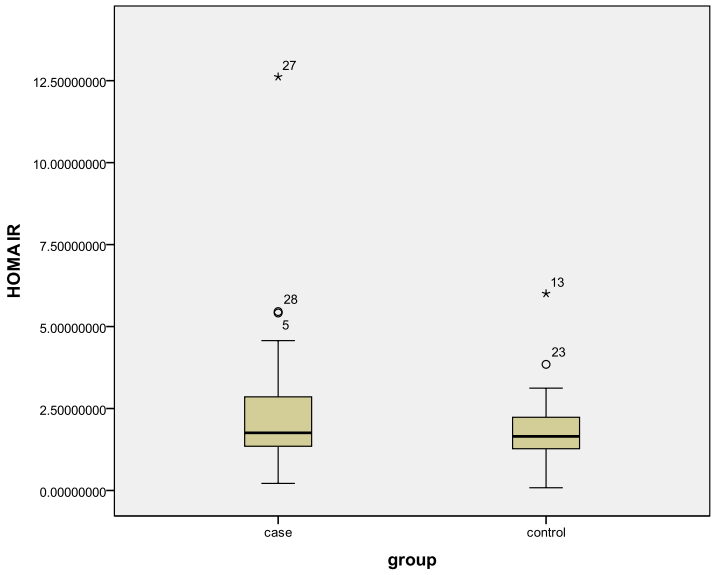

Figure (5):

Table (6): Comparisons of pre-diabetic prevalence in different study groups.

Pre-diabetic	Cases (N=24)		Control (N=24)		P-value	Sig.
	No.	%	No.	%		
Normal	17	70.8%	23	95.8%	**0.04**	**S**
Pre-diabetic	7	29.2%	1	4.2%		

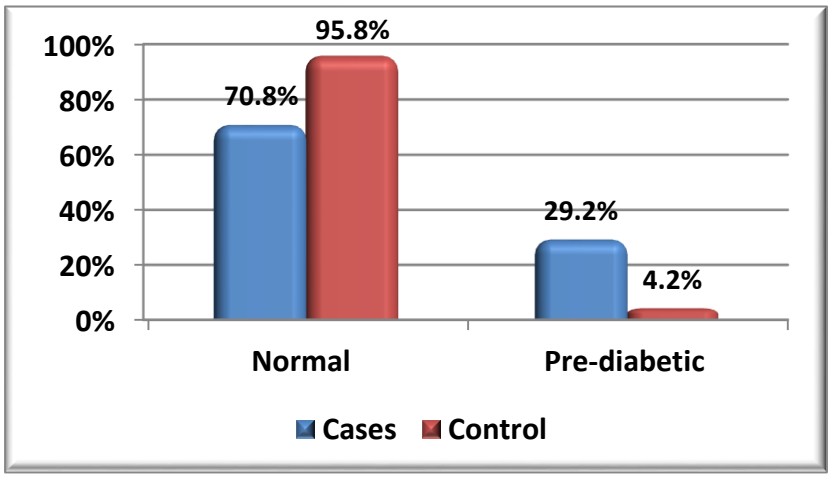

Figure (6):

The table illustrated that there was astatistical significant differencehigher percentage of pre-diabetic patients among case group 29.2% versus 4.2% in control group with p-value 0.04

Table (7): Comparisons of laboratory investigations in different study groups.

Variables	Cases (N=24)		Control (N=24)		P-value	Sig.
	Mean	SD	Mean	SD		
Albumin	3.9	0.24	4.4	0.45	**<0.001**	**HS**
Creatinine	0.73	0.13	0.76	0.13	**0.4**	**NS**
Triglyceride	180	57	129.3	15.6	**<0.001**	**HS**
Cholesterol	225.4	81.2	184.1	7.2	**0.01**	**S**

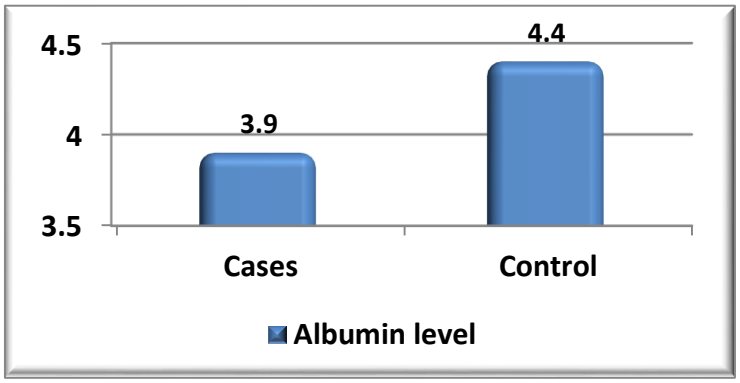

Figure (7):

The table illustrated that there was astatistical significant lower level of albumin and a higher level of triglyceride, and cholesterol level among cases group with p-value <0.001, <0.001, and 0.01 respectively.

On the other hand, there was no statistical significant difference with p-value 0.09 as regards creatinine level.

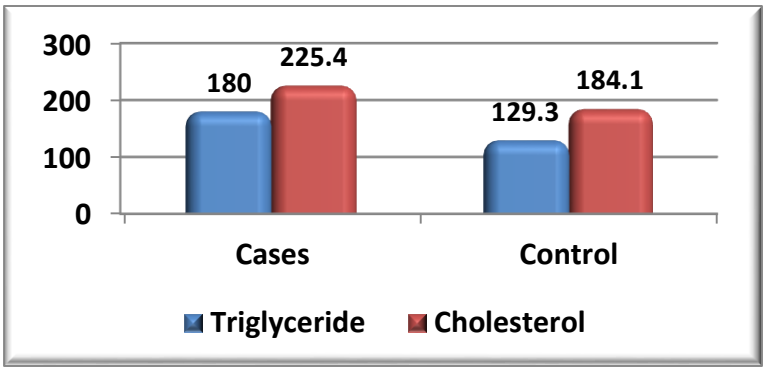

Figure (8):

Table (8): Comparisons of study variables between normal and pre- diabetic groups among cases.

Variables	Normal (N=17)		Pre-diabetic (N=7)		P-value	Sig.
	Median	Range	Median	Range		
Age	33	13-60	36	20-65	0.5	NS
BMI (kg/m^2)	23.9	20.7-25.4	23.9	21.5-25	0.2	NS
WC(cm)	80	70-88	82	79-84	0.6	NS
Systolic BP	120	100-130	110	100-120	0.2	NS
Diastolic BP	80	70-80	70	70-80	0.8	NS
FBS	76	62-100	117	104-126	**0.001**	**HS**
2hpp	124	103-137	140	114-169	**0.004**	**HS**
HbA1c	5.4	4.6-5.9	5.95	5.7-6.3	**0.001**	**HS**
Insulin level	7.9	0.4-51.1	9.7	4.9-17.8	0.5	NS
HOMA-IR	1.66	0.08-12.6	2.76	1.4-5.4	**0.03**	**S**
Albumin	4.1	3.5-5	3.9	3.6-4.5	0.1	NS
Creatinine	0.8	0.5-1	0.8	0.5-0.9	0.9	NS
Triglyceride	134.5	102-272	209	102-337	**0.02**	**S**
Cholesterol	183.5	135-412	221.5	186-386	**0.001**	**HS**

The table illustrated that there was no statistical significant difference with p-value >0.05 between normal and pre-diabetic patients among cases as regards age, BMI, waist circumference, blood pressure, and levels of insulin ,albumin, and creatinine.

However there was a statistical significance higher level of FBS, 2HPP, HbA1C, HOMA-IR, triglyceride, and cholesterol levels among pre-diabetic cases with p-value <0.05.

4. Discussion :

An autoimmune condition known as rheumatoid arthritis (RA) causes joint degeneration, pannus development, progressive bone erosion, and chronic synovial joint inflammation. Patients often exhibit joint pain and swelling, which can proceed to substantial impairment and significantly impair the patient's physical and emotional well-being . Around 1% of the world's population suffers from RA, and women are disproportionately affected . Rheumatoid factor (RF) and anti-citrullinated protein antibodies (ACPA) are two autoantibodies that can be found in blood before the onset or in the early stages of RA. Rheumatoid arthritis (RA) is a chronic, progressive, systemic pathological process. [7]. The risk of developing type 2 diabetes (T2D) is typically indicated by prediabetes, which is defined as a plasma glucose level that is beyond the normal range but not high enough to meet the diagnostic criteria for DM . Despite the fact that not all individuals with prediabetes go on to develop full-blown T2D, new epidemiological studies have demonstrated that individuals with prediabetes have a variety of vascular issues associated with T2D prior to receiving a diagnosis of DM. These complications are also linked to an increased risk of renal disease, cardiovascular morbidity and mortality, and other conditions. [6]

Autoimmune disorders that are complex and heterogeneous include rheumatoid arthritis (RA) and diabetes mellitus (DM). These disorders share a number of risk factors for their onset, such as metabolic changes , inflammation , and autoimmune responses to self-antigens, which produce autoantibodies . These illnesses are commonly acknowledged as having a significant impact on morbidity and mortality in the west, not least because of their close ties to cardiovascular disease. [11]

Based on this knowledge, this study was designed to assess the prevalence of prediabetes in a group of RA patients to emphasize its possible role as a risk factor for development of prediabetes in Egyptian population.

This study included 30 patients with RA (21 females and 9 males) at Beni-Suef university hospital through one-year duration. In the present study, FPG , 2HrPP , and HbA1c were done .

Our results showed that there was an association between Rheumatoid arthritis patients and prediabetes. The study illustrated that there was a statistical significant difference higher percentage of pre-diabetic patients among case group 29.2% versus 4.2% in control group with p-value 0.04 suggesting that Rheumatoid arthritis has a role as a risk factor for developing both prediabetes and DM occurrence.

Several case-controlled studies that looked into the prevalence of DM in RA patients revealed results that were comparable to ours . A study was conducted by PieroRuscitti et al., onitalian population. In this cross sectional, 500 consecutive RA patients and 500 age- and gender-matched controls were assessed. The patients were categorised using the 2010 ACR/EULAR and/or 1987 ACR Criteria. [8].

Although FPG did not significantly differ across the groups in this study, researchers eventually found that RA patients had a higher prevalence of IFGwhen compared to controls of the same age and gender (20.4% vs. 12.4%, P =.001), similar to the incidence of T2D. [8].

Furthermore , another cross sectional study was conducted in Medicine Department of Chittagong Medical College Hospital, Bangladesh . On the basis of blood sugar levels or HbA1C, 54 (36%) of the 150 RA patients were confirmed to be diabetic.Based on the results of the oral glucose tolerance test (OGTT) and HbA1C, the patients' glycemic status revealed that, of the 150 RA patients who participated, 57 (38%) had a normal glycemic status, 39 (26%) had prediabetes, and 54 (36%) had diabetes. [9].

In China, a significant retrospective population-based investigation was carried out. Participants in this study were recruited from a cohort of 6002 hospitalised patients with a minimum age of 20 who met the 2010 American College of Rheumatology (ACR)/EULAR classification criteria for RA at Guanghua Hospital of Traditional and Western Medicine. 10,759 healthy controls who were older than 20 at the time of the study were involved. 811 cases of T2DM and 1309 cases of IFG were found among controls. The prevalence of IFG was 12.19% overall (n = 1309) among healthy controls, with males being more likely to have it (14.50%; n = 1097) than females (6.68%; n = 212) (P 0.001).559 cases of T2DM and 451 cases of IFG were found among 5992 RA patients. IFG was present in 7.53% (n = 451) of the population overall, with males having a prevalence of 7.38% (n = 115) and females having a prevalence of 7.58% (n = 336) (P = 0.794). [10].

Contrary to these results , in a cross sectional Italian study , a total of 100 non-diabetic RA patients were enrolled in the current study. As controls, osteoarthritis or fibromyalgia patients who had non-inflammatory conditions were matched by age and sex.IFG (9/100 vs. 12/100, P = 0.49), IGT (19/100 vs. 12/100, P = 0.17), and combined IFG/IGT (5/100 vs. 9/100, P = 0.27) prevalence rates were comparable between groups [10].

Our results also showed statistical significant higher level of triglyceride, and cholesterol level among cases group with p-value <0.001, and 0.01 respectively when compared to controls .

This was in line with a cross-sectional observational study done with 200 patients with rheumatoid arthritis (RA) at the Jinnah Postgraduate Medical Center (JPMC) in Karachi. Results analysis revealed that 177 (88.5%) of the respondents were women and 23 (11.5%) men. The average age was 36.31 years with a mean disease duration of 3.82 years .[13].

Dyslipidemia was present in 107 individuals (53.5%). The average levels of HDL, LDL, and total cholesterol were 169.68 mg/dL, 40.02 mg/dL, and 93.29 mg/dL, respectively . When the lipid fractions of those with dyslipidemia were analysed, it was shown that 83 patients (41.5%) had low HDL, 16 (8%) had high TC, and 8 (4%) had low HDL combined with high LDL and high TC. .[13].

Furthermore, between January 2011 and December 2013, a cross-sectional three-year study on RA patients was carried out at the King Abdulaziz University Hospital in Saudi Arabia. There were 180 patients altogether. The majority of these patients were female, and more over half of the participants were Saudi. The cohort's average age was 40.49 ± 12.19 years, and the average duration of the RA disease was 5.51± 5.78 years. .[14].

Analysis of the relationship between high TC and various co-variables in the study population,based on independent t-tests, showed that TC was significantly associated with TG (p=0.005), low HDL (p=0.034), and high LDL (p=0.001). In addition, chi-square tests revealed that high TC was significantly associated with high TG (p=0.029) and high LDL (p<0.001), .[13].

Moreover, a study was carried out in the Rheumatology Unit's outpatient clinic at Rizgary Teaching Hospital in Erbil. 100 female patients with RA participated in this trial. The study's findings demonstrated that RA patients' (cases') serum TG levels were significantly higher than those of controls (P = 0.004). Among RA patients, the mean ± SD of serum TG was 148.8 70.9, while it was 116.4 ± 48.6 in the control group. Comparing

RA patients to controls, there was a significantly significant rise in serum total cholesterol (P 0.001). The mean ± SD of serum TC were 162.7± 33.6 in controls and 177.6± 39.2 in patients.(Hameed, S. B., 2017).

Further analysis of our study results showed that , although there was no statistically significant difference between cases and control regarding insulin level and HOMA-IR , but among cases only when comparing prediaetic patients with normoglycemic RA patients there was statistically siginificant difference in HOMA-IR with a p-value 0.03 .

Similar case-control research was conducted in the Department of Medicine at the Assam Medical College & Hospital in Dibrugarh, India, from July 1, 2017, to June 30, 2018, during a one-year period. 102 cases of rheumatoid arthritis as determined by the ACR/EULAR in 2010 and a comparable number of healthy controls with similar ages and sexes. The HOMA-IR model was used to calculate insulin resistance; those with results more than 2.5 were deemed to be insulin resistant. In this study, insulin resistance was present in 71.6% of patients and 21.4% of the control group. Despite the fact that the mean BMI of the patients was lower than that of the controls (22.78± 2.71 vs. 23.21± 3.20), the difference was not statistically significant.[15].

Another study, carried out at Tartu University Hospital in Estonia, included 321 participants in the control group (aged 20 to 79 years) and 92 patients with early RA (aged 19 to 79 years). 92 people with recently diagnosed RA according to ACR/EULAR 2010 criteria were included in the early RA group between 2012 and 2014. The individuals with ERA had considerably higher insulin values, even though there was no difference in the groups' glucose readings. Insulin resistance was defined as having a HOMA-IR value more than 2.15; 55% of ERA patients and 25% of control subjects fell into this category (p <0.001). Men were more likely than females to be classified as insulin-resistant, and there was a significant difference in the study groups between male patients and controls (73% versus 28%) (p <0.001). .[16].

5. Conclusion :

To conclude , the results of our study showed that there was a strong link between Rheumatoid arthritis and the likelihood of Egyptian patients getting prediabetes.

A significant limitation of our study is the insufficient sample size, which prevents us from conclusively determining the true prevalence of prediabetes in RA patients.

Ethics Approval And Consent To Participate:

This study was approved by the local research ethical committee in Beni-Suef University

hospital , Egypt.

Human And Animal Rights:

All procedures followed were in accordance with the ethical standards of the responsible

committee on human experimentation (institutional and national) and with the Helsinki

Declaration of 1975, as revised in 2008.

Consent For Publication:

Informed consent was obtained from all patients for being included in the study.

Availability Of Data And Materials:

The data used to support the findings of this study are included within the supplementary

information file.

Funding:

None.

Conflict Of Interest:

The authors declare no conflict of interest, financial or otherwise.

Acknowledgment:

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