The Effect of Diet and Exercise on Serum Lipids in Overweight and Obese Women with Polycystic Ovary Syndrome in Mosul city-2016

Najlaa Saadi Al Safar[1] **MBChB.** | **Lamia Dhia Al Deen**[2] **MBChB, MSc, PhD.** | **Besmah M. Ali**[3] **MBChB, FICMS.**

Abstract:-

Background:- Polycystic ovarian syndrome is a health problem affects women of childbearing age causing hormonal imbalance, that produce short & long term consequences on women health.

Aim of the study: To assess the effect of changing dietary habits and exercise on lipids profile in overweight or obese women with polycystic ovary syndrome .

Methodology: An interventional study on (200) women who are currently infertile, with polycystic ovary syndrome, overweight or obese, at reproductive age .The study was carried out during the period from 31of March till the 1st of October 2016 in outpatients clinic of fertility & sterility center in Al-batool Teaching hospital in Mosul city .The studied sample was divided into interventional(100)and non interventional(100)group..>. Collection of data was carried out bydirect interview with women according to pretested questionnaire.Measurement of weight and otheranthropometric,blood sugar, hormonal,and lipid profile measurement,. All these measures were done in first visit and repeated after three months follow up of the study period. All women in intervention group were given specific dietary advice and fitness program. The program included diet& exercise (lifestyle modification).

Results :-The total women studied were 188 (96 interventional group and 92 from control group). Most of the women using lifestyle intervention showed improvement in anthropometric, reproductive, androgenic features, hormonal and metabolic parameters in comparison with control group, and these differences were statically significant. The results of the study showed improvement in the conception rate(10%)in the interventional group in comparison with control group.

ConclusionChanging dietary habits and exercise can improve lipid profile and fertility rate in overweight /obese

Key word:-Diet,Exercise, Poly cystic ovary**.**

Introduction:-

Polycystic ovarian syndrome is a health problem affects women of childbearing age and an endocrine metabolic disturbances which has features of multiple hormonal imbalance that produce short & long term consequences on women health.(1).

The prevalence of polycystic ovarian syndrome varies depending on which criteria are used to make the diagnosis, but is high as 15-20% when the European society for human reproduction & Embryology \American Society for reproductive medicine criteria are used.(2).

In Iraq about 69.8% of women with PCOS were overweight. Prevalence of PCOS was more in younger women ≤ 35 years of age than older.(3)

Higher percentage of PCOS was found with obese women 42.28% (with BMI 30 -34.9 kg/m2).In this category, obesity and the abnormality of lipid profile parameters in women were suggestive for the increased risk of developing metabolic consequences and cardio vascular diseases.(4). PCOS management should focus on support and education, and needs to strongly emphasis healthy lifestyle, with targeted medical therapy as required.(5)

First line therapy for PCOS involves lifestyle modifications, including nutritional counseling and exercise to help stave off the threat of diabetes by promoting weight loss and improved glucose metabolism, both of which contribute to stabilization of some of the more distressing syndromes related to the condition.(6)The aim of this study was to assess the effect of changing dietary habits and exercise in overweight or obese women with polycystic ovary syndrome on their lipids profile.

Methodology:-

An interventional study on (200) women who are currently infertile, with polycystic ovary syndrome, overweight or obese, at reproductive age .The study was carried out during the period from 31of March till the 1st of October 2016 in outpatients clinic of fertility & sterility center in Al-batool Teaching hospital in Mosul city .The studied sample was divided into interventional (100)and non interventional (100)group.

Collection of data was carried out bydirect interview with women according to pretested questionnaire. Measurement of weight and other anthropometric, blood sugar, hormonal, and lipid profile measurement.

All these measures were done in first visit and repeated after three months follow up of the study period. All women in intervention group were given specific dietary advice and fitness program. The program included diet& exercise (lifestyle modification).

Everyinfertile women with polycystic ovary syndrome who were overweight or obese and at reproductive age (18-42) years and receive the diet & exercise intervention program was assigned intervention group.

Every infertile women with polycystic ovary syndrome women who were overweight or obese and at reproductive age (18-42) years and who did not receive the diet & exercise intervention program was assigned as non interventional. The data collection process was conducted through attending the fertility& sterility center three days per week during the working hours of the center (from 8 am to 1 pm).

Out of 213 women fit to the criteria of the study were interviewed, 200 women agreed to participate in the study giving (response rate of 94%). The data were collected by the researcher through direct interview with women according to a questionnaire which consists of socio-demographic**,** reproductive and androgenic characteristics**.**

The Anthropometric measurement includes (weight), (height), waist circumference (WC), hip circumference (HC \cm) & waist hip ratio (WHR) and body mass index (BMI) was calculated. All these measures were done in first visit and repeated after three months follow up of the study period**.**

Laboratory tests were done for all studied women, at the fertility and sterility center laboratory; venous blood was tested for- fasting blood glucose Luteinizing (LH)& follicular stimulating hormones (FSH), Lipid profile test which include; total cholesterol(TC), Triglyceride (TG),High density lipoprotein(HDL), Low density lipoprotein (LDL), Very low density lipoprotein (VLDL) and Atherogenic index.

The researcher advised all women in the intervention group about the specific dietary instructions (according to a specific card meal), that included ,lower fat diet, lean protein sources, reduced dairy product and eating foods with a low glycemic index).[7-9]. The physical activity was achieved through at least (30min\day\5time\week) of briskly walking (exercise at moderate level of intensity).[10]

Data analysis and statistical tests:

Each questionnaire was assigned a serial identification number, were data categorization and coding performed via Microsoft Excel-2007. Descriptive and analytic statistics was carried out by using Minitab version 16.2 software statistical program.The data was summarized and presented as frequency and percent& tables. Independent t-test for two means (unpaired) was used for comparison between each two quantitative parameters. Dependent t-test for two means (paired) was applied for the differences in intervention group (before – after). Chi-square test was used for comparison between categorical variables. P-values ≤ 0.05 were considered statistically significant.

Results:-

Out of 200 eligible infertile women approached from the fertility & sterility center in Mosul, Only 188 women completed (loss of follow-up 12 women). The distribution of basic socio-demographic, obstetric and androgenic features for enrolled women are shown in Table (1). The mean age of women in the intervention group was (25.0±5.7) years &non intervention was (25.6±5.3) years (range 18-42)years There were no statistically significant difference in a mean age, (p=0.415). For the participants in intervention group the average age at marriage was (18.7 ±3.5) years and participants in other group was (19.8 ± 4.6) years. The average duration of current infertility was (4.5 ± 2.8) years in intervention group and in the non intervention was (4.9 ± 3.1) years.

Regarding the obstetric and androgenic characteristics, table (1) shows an increase in the percentage of infertility, hirsutisim, acne, scalp hair loss and irregularity of menstrual cycle in both groups as it is expected in women with PCOS. The majority of participants in both groups (64.5%), (77.2%) respectively had primary infertility and only (35.5%), (22.8%) had secondary infertility.

Table (2) demonstrates distribution of studied groups according to their anthropometric characteristics, hormonal and metabolic parameters at baseline.

Table (3) showed distribution of the interviewed women according to their reproductive and metabolic parameters. The participants in test group had a significant reduction in fasting blood sugar with a mean difference 7.1±5.0mg\dl, p=<0.05, whereas the women in the other group had a mean difference -1.3mg\dl.

As seen in table (3) the changes in the lipid profile parameters, most of the women in intervention group had a significant improvement in lipid profile P=0.000. The mean differences of TC, LDL, TG & VLDL were (19.9±9.5 mg\dl), (46.4 ±23.0mg\dl), (18.1±10.3mg\dl), (9.4±4.6mg\dl) respectively, there are significantly reduction in intervention group than those in the other group with a mean differences (-2.3±7.0mg\dl), (-6.7±14.8mg\dl), (-2.9±8.2mg\dl),(-1.7±3.4mg\dl) respectively.

There were statistically significant improvement in serum level of HDL in intervention group with a mean difference -7.7±5.2mg\dl than those in control group had a mean difference 2.3±3.7mg\dl. Table(4) illustrate the anthropometric characteristics and hormonal, metabolic parameters which were statistically significant among intervention group after intervention. The average weight loss in women among intervention group was 6.02kg and percentage improvement rates(PIR) were 8%. The BMI, WC, HC, WHR reduction in these women were(2.6,4.4,4.8,0.01) and PIR were (8.1%,5%,4.4%.0.7%) respectively. All these characteristics were significant, (p=0.000).The women among intervention group had significant decrease in the mean of FBS level 7.1mg\dl and PIR7.7%. Regarding the LH among these women had significant differences and the PIR of LH (12.4%). Concerning the lipid parameters in women among intervention group, they had a higher significant differences, p=0.000. The mean differences of the TC, TG, HDL, LDL, VLDL were (19.9, 46.4, -7.7, 18.1, 9.4)mg\dl respectively. The higher PIR are observed in these lipid parameters among these women (10.4%, 27.6%, 20.4%, 15.1%, 27.9%) respectively.

Table(1):Distribution of studied sample according to their Socio-Demographic, obstetric characteristics and androgenic features in the study groups at baseline, Mosul, 2016, n=188.

Characteristics		Intervention (n=96) M±SD		No intervention (n=92) M±SD	
Mean age (years)		**25.0 ± 5.7**		**25.6 ± 5.3**	
Mean age at marriage (years)		**18.7 ± 3.5**		**19.8 ± 4.6**	
Mean duration of infertility (years)		**4.5± 2.8**		**4.9 ± 3.1**	
		No.	**%**	**No.**	**%**
Residence :	- Urban	**70**	**72.9**	**72**	**78.3**
	- Rural	**26**	**27.8**	**20**	**21.7**
Education levels:	- Illiterate	**23**	**24.0**	**26**	**28.3**
	- Primary	**47**	**49.0**	**45**	**48.9**
	- Secondary	**18**	**18.7**	**9**	**9.8**
	- University +	**8**	**8.3**	**12**	**13.0**
Occupation:	- House wives	**92**	**95.8**	**87**	**94.6**
	- Employees	**4**	**4.2**	**5**	**5.4**
Type of infertility :	- Primary	**62**	**64.5**	**71**	**77.2**
	- Secondary	**34**	**35.5**	**21**	**22.8**
Menstrual cycle:	- Regular	**22**	**22.9**	**47**	**51.1**
	- Oligomenorrhea	**65**	**67.7**	**43**	**46.7**
	- Amenorrhea	**9**	**9.4**	**2**	**2.2**
Hirsutism		**77**	**80.2**	**68**	**73.9**
Acne		**67**	**69.8**	**62**	**67.4**
Scalp hair loss		**76**	**79.2**	**64**	**69.8**

Table(2):Distribution of studied women according to their Anthropometric characteristics, hormonal and metabolic parameters in both study groups at baseline, Mosul, 2016, n=188.

Variables	Intervention group M±SD (n=96)		No intervention M±SD (n=92)	
Weight (Kg)	**75.8 ± 11.1**		**76.1 ± 12.9**	
BMI (Kg/m^2)	**31.5 ± 4.5**		**31.1 ± 5.4**	
Waist circumference (Cm)	**88.4 ± 8.8**		**88.9 ± 11.6**	
Hip circumference (Cm)	**107.9 ± 6.9**		**107.4 ± 9.0**	
W/H ratio	**0.82 ± 0.05**		**0.82 ± 0.05**	
FBS (mg/dL)	**91.6 ± 12.5**		**86.3 ± 11.4**	
LH (mIU/mL)	**7.1 ± 3.8**		**7.4 ± 4.4**	
FSH (mIU/mL)	**6.5 ± 3.4**		**6.6 ± 3.4**	
TC (mg/dL)	**191.4 ± 31.6**		**196.3 ± 30.3**	
TG (mg/dL)	**168.1 ± 37.1**		**161.7 ± 35.2**	
HDL (mg/dL)	**37.8 ± 8.1**		**39.9 ± 7.3**	
LDL (mg/dL)	**119.9 ± 29.6**		**124.0 ± 27.1**	
VLDL (mg/dL)	**33.8 ± 7.6**		**32.3 ± 7.1**	
Atherogenic index	**5.3 ± 1.7**		**5.1± 1.3**	
BMI category:	**No.**	**%**	**No.**	**%**
Overweight (25 – 29.99)	**42**	**43.8**	**51**	**55.4**
Obesity (≥30)	**54**	**56.2**	**41**	**44.6**

Table (3):Comparison the anthropometric and biochemical measurements between the two study groups after three months of the study, Mosul, 2016, n=188.

Parameters	Intervention [n=96]M±SD	No intervention [n=92]M±SD	P-value*
Weight (Kg)	**69.7 ± 10.5**	**77.1 ± 12.5**	**0.000**
BMI (Kg/m^2)	**29.0 ± 4.2**	**31.6 ± 5.3**	**0.000**
Waist circumference (Cm)	**84.0 ± 8.5**	**89.8 ± 11.3**	**0.000**
Hip circumference (Cm)	**103.1 ± 6.6**	**108.1 ± 9.3**	**0.000**
W/H ratio	**0.81 ± 0.05**	**0.83 ± 0.05**	**0.069**
FBS (mg/dL)	**84.6 ± 11.1**	**87.6 ± 11.1**	**0.070**
LH (mIU/mL)	**6.2 ± 3.1**	**7.9 ± 4.4**	**0.004**
FSH (mIU/mL)	**6.3 ± 2.2**	**6.8 ± 3.2**	**0.232**
TC (mg/dL)	**171.6 ± 30.1**	**198.5 ± 28.4**	**0.000**
TG (mg/dL)	**121.7 ± 39.8**	**168.4 ± 32.9**	**0.000**
HDL (mg/dL)	**45.5 ± 8.9**	**37.7 ± 6.8**	**0.000**
LDL (mg/dL)	**101.8 ± 29.2**	**126.9 ± 25.4**	**0.000**
VLDL (mg/dL)	**24.4 ± 8.0**	**34.0 ± 7.0**	**0.000**
Atherogenic index	**3.9 ± 1.2**	**5.4 ± 1.3**	**0.000**
BMI category:	**No. (%)**	**No. (%)**	**---**
Normal (18 – 24.99)	**15 (15.6)**	**0 (0.0)**	
Overweight (25 – 29.99)	**47 (49.0)**	**42 (45.7)**	
Obesity (≥30)	**34 (35.4)**	**50 (54.4)**	**0.0001****

*** Independent t-test of two means was used.** Chi-square test was used, d.f = 2.**

Table (4 : Percentage Improvement rates in anthropometric and metabolic parameters of intervention groups ,Mosul,2016 ,n=96.

Parameters	Beginning Mean ± SD	After 3 months Mean ± SD	Before – after	% improvement rate	P-value*
Weight (Kg)	**75.8 ± 11.1**	**69.7 ± 10.5**	**6.02**	**8.0**	**0.000**
BMI (Kg/m^2)	**31.5 ± 4.5**	**29.0 ± 4.2**	**2.6**	**8.1**	**0.000**
WC (Cm)	**88.4 ± 8.8**	**84.0 ± 8.5**	**4.4**	**5.0**	**0.000**
HC (Cm)	**107.9 ± 6.9**	**103.1 ± 6.6**	**4.8**	**4.4**	**0.000**
W/H ratio	**0.82 ± 0.05**	**0.81 ± 0.05**	**0.01**	**0.7**	**0.0001**
FBS (mg/dL)	**91.6 ± 12.5**	**84.6 ± 11.1**	**7.1**	**7.7**	**0.000**
LH (mIU/mL)	**7.1 ± 3.8**	**6.2 ± 3.1**	**0.88**	**12.4**	**0.000**
FSH (mIU/mL)	**6.5 ± 3.4**	**6.3 ± 2.7**	**0.23**	**3.5**	**0.169**
TC (mg/dL)	**191.4 ± 31.6**	**171.6 ± 30.1**	**19.9**	**10.4**	**0.000**
TG (mg/dL)	**168.1 ± 37.1**	**121.7 ± 39.8**	**46.4**	**27.6**	**0.000**
HDL (mg/dL)	**37.8 ± 8.1**	**45.5 ± 8.9**	**- 7.7**	**20.4**	**0.000**
LDL (mg/dL)	**119.9 ± 29.6**	**101.8 ± 29.2**	**18.1**	**15.1**	**0.000**
VLDL (mg/dL)	**33.8 ± 7.6**	**24.4 ± 8.0**	**9.4**	**27.9**	**0.000**
Atherogenic index	**5.3 ± 1.7**	**3.9 ± 1.2**	**1.4**	**25.6**	**0.000**

***paired t-test of two means was used.**
%Improvement rate =(before intervention –after intervention) / before intervention × 100.

The results of this study (table 5) revealed a highly significant difference regarding hirsutism, acne and scalp hair loss among intervention group versus the control group. These androgenic features were found to be improved significantly (decreased) post intervention in intervention groups, this means that the intervention had positive effect in deceasing hirsutism by 32.8%, p=0.000.**).** Comparison of the conception rates between two study groups after three months of follow revealed , the pregnancy rates of the women among intervention group was 10(10.4%) which were statistically significant ,in comparison with(1.1%) pregnancy rates of the women among non interventional group (table 6).

Table(5):Comparison in the menstrual cycle and androgenic features between two groups after three months of thestudy,Mosul,2016, n=188.

Items	Intervention [n =96]		No intervention [n =92]		P-value*
	No.	**%**	**No.**	**%**	
Menstrual cycle:					
Regular	**64**	**66.7**	**42**	**45.7**	
Irregular (Oligomenorrhea+ Amenorrhea)	**32**	**33.3**	**50**	**54.3**	**0.003**
Hirsutism	**45**	**47.4**	**68**	**73.9**	**0.000**
Acne	**26**	**27.1**	**48**	**52.2**	**0.000**
Scalp hair loss	**14**	**14.6**	**43**	**46.7**	**0.000**

*** chi- square test was use**

Table (6):Comparison of the conception rates between two study groups after three months of follow up,Mosul,2016, n=188.

Conception	Intervention group (n=96)	No intervention(n=92)	P-value
Conceived	**10 (10.4)**	**1 (1.1)**	**0.006***
Not conceived	**86 (89.6)**	**91 (98.9)**	

Values are expressed as number (%).* chi- square test was used ,d.f=1

Discussion

One hundred eighty eight PCOS women were completed the study ,the mean age of participants in both intervention and control groups were 25 years and 25.6 years respectively(as shown in table 1). These figures coincides with other studies in Iraq, where the prevalence of PCOS was more in younger women ≤35years of age.[3,11]

In this study, the two studied groups (intervention & control groups) at base line had higher values of WC (88.4 ±8.8) & (88.9±11.6) respectively. Whereas the WHR was identical in both groups. The current study shows that both groups had WHR >0.80 cm. These findings were in agreement with several studies in Iraq which reported that higher WC >88 cm and WHR >0.80 in association with PCOS.[11 - 13]Also it is similar to the findings from Egypt, Brazil and Canada were reported that WC was higher in PCOS women.[14-16]

Concerning metabolic feature of PCOS women (Table 3), the present results at baseline showed that women with PCOS had normal level of fasting blood sugar in both groups. The hormonal measurement in both groups showed high LH at base line. The current study also showed that PCOS women in both groups had abnormal lipid profile (increase the levels of TG, LDL &decrease levels of HDL). This result is in consistent with what were reported by other workers.[4,,13]The present study showed that women in intervention group showed greater significant reduction in weight,BMI,WC,HC,WHR and no reduction in control group, P=0.0000.This finding is closed to the findings reported by other workers.[17,18]

According to the finding obtained from the present study, using lifestyle intervention (diet & exercise) can be considered preferable advice for every women with PCOS to concerte on her diet & increase physical activity during the day. This finding is close to the findings from previous studies,where they reported that the lifestyle modification is considered as the preferred first-line treatment for PCOS with improvementin the androgenic features, metabolic risk factors and restore reproductive function. [18,19] The current results showed a significant improvement in weight and other anthropometric characteristics were in consistent with results of other workers, who reported that physical activity, weight loss, appears to be associated with improvements in body composition and metabolic conditions.[20]

This study revealed an increase in LH to the FSH in women with PCOS at baseline (table 4) in both groups which represent a characteristic features in PCOS, it also revealed a highly significant difference in LH, FBS between pre and post intervention within interventional group and in comparison with control group, p=0.000. The intervention reduced the levels of this parameters among intervention group, moreover, this parameters were higher after three months of follow up in control group. Thissuggest that the interventiondecreased the levels of LH& FBS with (12.4% &7.7%) percentage improvement rates. This is in congruent with the results reported by other studies.[21,22]

This study revealed a highly significant reduction in lipid parameters in intervention group in comparison to the control group, p=0.000, and a significant improvement of the lipid parameters post intervention in comparison to pre intervention within intervention group, with percentage improvement rates of HDL,TC, LDL,VLDL, atherogenic index were (20.4%,10.4%,27.6%,

15.1%, 27.9%, 25.6%) respectively, (p=0.000). This result in consistent with findings of study conducted by Abazar et al.[17]Who found that reducing the weight by exercise after 12 weeks in obese\ overweight women with PCOS can correct lipoprotein profile.

The results ofthis study (table 5) revealed a highly significant difference regarding hirsutism,acne and scalp hair loss among intervention group versus the control group. These androgenic features were found to be improved significantly (decreased) post intervention in intervention groups, this means that the intervention had positive effect in deceasing hirsutism by 32.8%, p=0.000.This finding in congruent with previous studies where they reported that, lifestyle modification\ weight reduction in overweight or obese women diagnosed with PCOS had alleviating of some symptoms, improve hormonal profile &hyperandrogenic feature.[1417,22]

The results in the current study support hypothesis improving menstrual cycle and fertility in overweight /obese PCOS women by using a dietary changes and exercise that lead to weight loss, the studied women were able to compliance for the diet program and exercise for three months period, resulted in significant reduction in their anthropometric measures, weight loss and hence improve in their likelihood of pregnancy,since 10(10.4%) out of 96 women in the intervention group became pregnant (as shown in table 6). Same finding was reported by other worker where post lifestyle intervention with weight loss leads to improve in the frequency of menstrual cycle, ovulation and their likelihood of pregnancy in overweight /obese women with PCOS.[22]

References

1-Akram H. Secretor Frequency and H-Substance Level in Poly cystic Ovary Syndrome patients and ApparentlyHealthControls.Int.J.Curr.Microbiol.App.Sci.2016;5 (1):706-712. Available from: http://www.ijcmas.com/vol-5-1/Haneen%20Akram.pdf

2-Sirmans S M, Pate K A. Epidemiology ,diagnosis and management of polycystic ovary syndrome .Clinical Epidemiology,Dovepress.18 ,December 2014; 6: 1-3.Available from: https://doi.org/10.2147/clep.s37559-

3--Abdul-Nabi M A.The effect of atorvastatin, metformin or their combination in unmarried woman with polycystic ovarysyndrome.University of Baghdad,collage of pharmacy .2013. Available from: http://www.copharm.uobaghdad.edu.iq/uploads/activities%202014/phd%20thesis%202013/metham%20ali.pdf

4-AL-Tu'ma F J, Farhan N H,AL-Safi WG. Association between fat mass and obesity Geners 9939609 polymorphism with PCOS women in Iraqi population. Human Journals.25 De i-Al-Safi.pdf cember 2015; 5 (1):62-72 . Available from: http://ijppr.humanjournals.com/wp-content/uploads/2015/12/5.Fadhil-Jawad-Al-Tuma-Noor-HadiFarhan-and-Wasan-Ghaz

5-Teede H J, Misso M L, Deeks A A, Moran L J, Stuckey B G A, Wong J L, et al. Assessment and management of polycystic ovary syndrome: Summary of an evidence-based guideline. Polycystic ovary syndrome association of Australia INC.(POSAA).19 September 2011.195(6).Available from: https://www.mja.com.au/journal/2011/195/6/assessment-and-management-polycystic-ovary-syndrome-summary-evidence-based.

6-Vause T, Cheung A, Sierra S, Claman P, Graham J, Guillemin Jo-A, et al. Ovulation induction in polycystic ovary syndrome. SOGC clinical practice guideline.May 2010; (242).Available from: http://old.sogc.org/guidelines/ovulation-induction-in-polycystic-ovary-syndrome/

7-Williams M.Nutrition for health, fitness & sport.10th ed.Duluth (Mn): McGraw-Hill Education: 2013: 666.Available from: https://cehsp.d.umn.edu/sites/cehsp.d.umn.edu/files/theeffectsofnutritionandexerciseonpolycysticovarysyndrome.pd.

8- Sorensen L B, Soe M, Halkier K H, Stigsby B, Astrup A. Effects of increased dietary protein-to-carbohydrate ratios in women with polycystic ovary syndrome. The American Journal of Clinical Nutrition .2012; 95(1):39-48.Available from: http://ajcn.nutrition.org/content/95/1/39.full

9- Benner A. The effects of Nutrition and exercise on polycystic ovary syndrome.Fertility solution.December ;2013: 1-7 Available from: https://cehsp.d.umn.edu/sites/cehsp.d.umn.edu/files/theeffectsofnutritionandexerciseonpolycysticovarysyndrome.pdf

10--Be Active Your Way.Aguide for adults;based on the 2008 physical activity guidelines for Americans .ODPHP puplication No.U0037.October 2008.Available from: https://health.gov/PAGuidelines/pdf/adultguide.pdf

11-Hussein B, Alalaf S. Prevalence and characteristics of polycystic ovarian syndrome in a sample of infertile Kurdish women attending IVF infertility center in maternity teaching hospital of Erbil city. Open Journal of Obstetrics and Gynecology(OJOC).2013; 3: 577-585 . Available from: http://dx.doi.org/10.4236/ojog.2013.37104

12-Kowalik A, Rachon D. Dietary interventions in the treatment of women with polycystic ovary syndrome .Nutrition

,Obesity&Metabolic Surgery . 2014;1,1: 14-19. Available from: https://doi.org/10.5114/noms.2014.44565

13-AL-Waeely F A, Ajlaan S K,AL-Assadi A F, Nsaif E M. The prevalence of metabolic syndrome in patients with polycystic ovary syndrome. The-Qar Medical Journal(TQMI).2011; 5(3):94-102.Available from: http://basmedcol.edu.iq/media/2013/12/The-prevalence-of-metabolic-syndrome-in-patients-with-polycy.pdf

14- AbdElmenim S O, Mohamed EmamA M. Effect of lifestyle changes on symptoms of polycystic ovarian syndrome in obese girls. IOSR-JNHS.March-April 2016; 5(3) ver II.Available from: http://www.iosrjournals.org/iosr-jnhs/papers/vol5-issue3/Version-2/A0503020110.pdf

15- Ramos F K P, Lara L A de S, Kogure G S, Silva R C, Ferriani R A, de Sa M F S.et al, Quality of life in women with polycystic ovary syndrome after a orogram of resistance exercise training. ThiemepublicacoesLtda, Rio de Janeiro,Brazil.23July 2016;38(7):340-347.Available from: https://www.ncbi.nlm.nih.gov/pubmed/27472811

16- Pasquali R, Gambineri A, Biscotti D, Vicennati V, Gagliardi L, Colitta D, et al. Effect of long-term treatment with metformin added to hypocaloric diet on body composition, fat distribution, and androgen and insulin levels in abdominally obese women with and without the polycystic ovary syndrome. The Journal of Clinical Endocrinology&Metabolism.25April 2011; 85(8):2767-2774.Available from: https://doi.org/10.1210/jcem.85.8.6738

17-Abazar E, Taghian F, Mardanian F, Forozandeh D. Effects of aerobic exercise on plasma lipoproteins in overweight and obese women with polycystic ovary syndrome. Adv Bio Med Res.25March2015;4:68. Available from: https://doi.org/10.4103/2277-9175.153892

18- Fadhil A Z, AL-Dahhan F. The effect of metformin on serum lipids in overweight and obese patients with polycystic ovary syndrome. Iraq post graduate medical journal.2014:13(3).Available from: http://iasj.net/iasj?func=fulltext&aId=93437

19-Mahendru R. Weight Loss and Fitness Expo. OMICS International Conference, Philadelphia USA,JObes Weight Loss Ther.13-15 July 2015;5:3 .Available from: http://dx.doi.org/10.4172/2165-7904.S1.017

20- HaqqL,McFarlane J, Dieberg G, Smart N. Effect of lifestyle intervention on the reproductive endocrine profile in women with polycystic ovarian syndrome; a systematic review and meta-analysis, Endocrine Connections.31January 2014;3:36-46.Available from: https://doi.org/10.1530/EC-14-0010

21- Badawy A, Elnashare A. Treatment options for polycystic ovary syndrome. Dovepress, Int J Women's Health.8February 2011; 3:25-35.Available from: https://doi.org/10.2147/ijwh.s11304

22- Ahmed EMS, Salem M E, Sweed M S E. Effect of lifestyle modifications on polycystic ovarian syndrome symptoms. Journal of American Science.2012;8(8). Available from: http://www.jofamericanscience.org/journals/amsci/am0808/082_10164am0808_535_544.pdf

1- MoH
2- Dept. of Community Medicine Al-Mustansiryiah College of Medicine.