Scholar Publishing Group
International Journal of Public Health and Preventive Medicine
https://doi.org/10.38007/IJPHPM.2023.040102
ISSN 2789-8377 Vol. 4, Issue 1: 9-17

Treatment of Polycystic Ovary Syndrome by Liver and Spleen Based Browning of white Adipose

Jinyuan Zhang[1, a] and Xinchun Xiao[2, b*]

[1]*Shaanxi University of Chinese Medicine, Xianyang 712046, Shaanxi, China*

[2]*The Affiliated Hospital of Shaanxi University of Chinese Medicine, Xianyang 712000, China*

[a]*2356030014@qq.com*, [b]*xxchsd2003@163.com*

[*]*corresponding author*

Keywords: White Adipose Tissue, Brown Adipose Tissue, Spleen, Renal, Polycystic Ovary Syndrome.

Abstract: Polycystic ovary syndrome (PCOS) is a major disease causing modern women's metabolic disorders, irregular menstruation, infertility, and other symptoms. In addition, the etiology and pathology of PCOS is still not thoroughly studied, so it has become a difficult and complicated disease endangering women's health. Obesity is one of its typical manifestations, and patients often present central obesity. With the in-depth study of modern medicine, people find that obesity plays an important role in regulating the immune inflammatory response and metabolism of the human body, and the change in the distribution ratio of white fat and brown fat in the patient is the root cause of a series of metabolic disorders. At the same time, the role of the two fats in the human body is similar to that of spleen and kidney in many aspects. Coupled with a growing number of experimental studies prove that polycystic ovary syndrome patients lose weight of significant effect on the disease rehabilitation, this paper aims to explore the white fat brown and the relationship between the TCM spleen and kidney, in order to find more effective traditional Chinese and western medicine treatment for polycystic ovary syndrome.

1. Introduction

Polycystic Ovary Syndrome (PCOS) is a group of diseases with metabolic disorders as the main manifestations. Patients often present with central obesity, menstrual disorders, amenorrhea, insulin resistance, infertility, etc., which seriously endangers women's physical and mental health. But with people's in-depth research we found that its common symptoms have an inseparable relationship with human metabolic disorders and inflammatory reaction. The different composition of human

adipocytes plays an important role in metabolism and inflammation, so regulating adipocytes is one of the treatment ideas for this disease[1].

2. Effects of BAT and WAT Adipose on Metabolism and Their Transformation

2.1. The Function and Metabolic Effects of WAT in Human Body

WAT is one of the most energy-storing cells found in the human body. Adipocytes are monolocular large lipid droplets, which confer the energy storage capacity and homeostasis of white fat in response to nutritional demands. When the energy is too high, its volume increases and the quantity increases to store excess energy[2]. When the energy is insufficient, it dissolves and synthesizes adenosine triphosphate as an energy material to meet the energy demand of the human body. At the same time, it is also an important endocrine organ, which can secrete a variety of adipokines (such as adiponectin and leptin, etc.), and then regulate the function of other organs and corresponding hormone secretion. For example, leptin can promote GnRH, secreted by the hypothalamus, to stimulate the pituitary to release FSH and LH, and promote the development of follicles and the discharge of the ovum. Adiponectin is associated with insulin resistance, obesity, oxidative stress, and inflammation in PCOS patients[3].

WAT in the human body can be classified according to its distribution in two different repositories: visceral white adipose tissue (vWAT), mainly distributed in the omentum, mesentery, retroperitoneal, gonad and pericardium, and subcutaneous white adipose tissue (sWAT) (Figure 1).

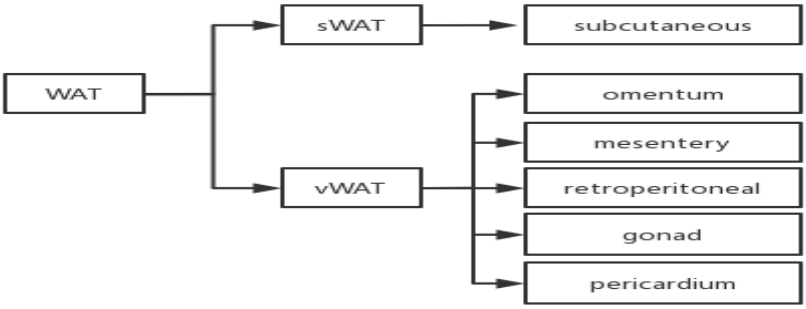

Figure 1. The function of WAT

vWAT has larger adipocytes than sWAT. Although larger adipocytes represent stronger energy storage capacity, studies have shown that the energy imbalance in obesity leads to adipocyte hypertrophy, which is associated with adipose tissue dysfunction and metabolic complications. For example, studies have found that the increase of subcutaneous fat is often negatively correlated with insulin resistance and metabolic function, while the increase of visceral adipose and other large adipocytes is often positively correlated with it[4]. vWAT often induces a series of inflammatory reactions, metabolic disorders, blood glucose disorders, etc., It can be seen that obesity, especially the increase of tissues mainly composed of large adipocytes such as vWAT, is a major cause of metabolic disorders in the human body, which is also the characteristic of central obesity and the concentration of adipose tissue in the viscera in PCOS patients. It mainly affects endocrine and metabolism causing the corresponding symptoms of PCOS by secreting inflammatory factors such as TNF-α and IL-6. The effect of TNF-α is closely related to obesity-related insulin resistance, which has been confirmed to reduce insulin signaling through IRS1 inhibition of the insulin signaling pathway. One of the typical manifestations of PCOS patients is hyperandrogenemia. IL-6 can increase the activity of androgen by upregulating the expression of T receptor in ovarian tissue,

and hyperandrogenemia can also act on IL-6 to reduce the activity of AKT, thereby affecting the insulin signaling pathway and causing insulin resistance and hyperinsulinemia.

2.2. The Function and Metabolic Effects of BAT in Human Body

The main functions of BAT are adaptive thermogenesis and secretion function. As early as the last century, it has been found that BAT has high metabolic activity. When the ambient temperature decreases, energy saving mechanisms such as vascular constriction and movement reduction will be activated and induce adaptive thermogenesis, which is formed by activating the thermogenesis mechanism of BAT. The thermogenic ability of BAT is formed by the expression of uncoupling protein 1 (UCP1), which is located in the mitochondrial membrane of BAT. When exposed to a cold environment, UCP1 can trigger the release of norepinephrine from sympathetic nerve endings. Furthermore, β-adrenergic receptors stimulate the expression of UCP1 in BAT, which can promote aerobic respiration in mitochondria and the production of adenosine triphosphate (ATP) for uncoupling, so that BAT releases a large amount of chemical energy in the form of non-shivering thermogenesis(Figure 2). Causing energy to dissipate as heat. This exothermic process is driven by the hydrolysis of triglycerides and the oxidation of fatty acids as the main energy metabolism. Meanwhile, the oxidation of fatty acids, as an activator of UCP1, is also an indispensable element of BAT thermogenesis, suggesting that the activation of BAT may lead to the reduction of energy storage in WAT, thereby alleviating obesity and its harmful sequelae. For example, Andreas[5] found that BAT is related to the reduction of liver fat accumulation, especially in central obese individuals, indicating that BAT is beneficial to central obesity in patients with polycystic ovary syndrome.

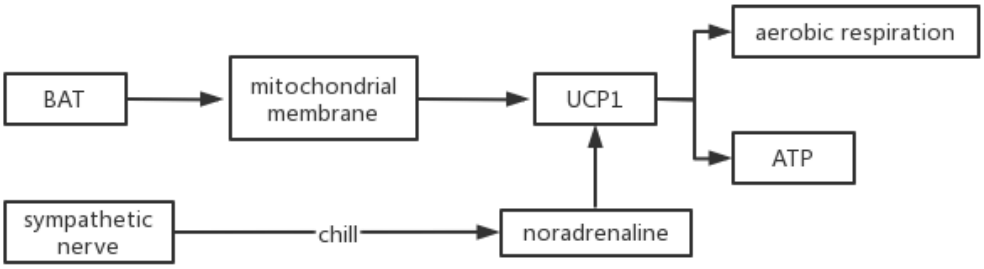

Figure 2. The function of BAT

At the same time, the existence of BAT can improve the glucolipid metabolism and the environment of human body metabolization disorder, and low blood sugar, white blood cell count, and elevated triglycerides and high-density lipoprotein cholesterol (hdl-c), associated with a lower prevalence of type 2 diabetes, this is because the BAT activation can secrete a variety of cytokines, such as vascular endothelial growth factor (VEGF), nerve growth factor (NGF plays), And fibroblast growth factor 21 (FGF21). VEGF plays an important role in human physiological development and angiogenesis. The expression level of VEGF in the ovary of PCOS patients is significantly increased, and VEGF is associated with the hyperplasia of ovarian stromal and intimal neovascularization in PCOS patients. The levels of NGF in serum and follicular fluid of PCOS patients were higher than those of non-PCOS patients. Chen Bingjin et al. [31] proved through experiments that NGF receptor TrkA was mainly expressed in mature follicles, NGF-TRKA may be involved in follicular development, and maturation, and overexpression of NGF may be one of the pathological mechanisms of PCOS. FGF21 is an important regulator of insulin sensitivity and systemic metabolism, which can promote glucose uptake in adipose tissue of mice and humans, and has a lipolysis effect[6-7].

2.3. WAT and BAT Conversion

In summary, promoting WAT Browning is of great significance for the regulation and improvement of metabolic disorders in clinical obese patients, and it is also a hot topic in Western medicine treatment of obese patients in recent years. Studies have shown that WAT Browning is driven by norepinephrine released by sympathetic nerves[8-9]. Norepinephrine stimulates lipolysis and upregulates UCP1 through cyclic adenosine phosphate (cAMP). On the contrary, BAT can be converted into WAT, which leads to fewer mitochondria and reduced oxidation capacity, UCP1 protein, and thermoelectric potential. This transformation mostly occurs under thermoneutral conditions, and sympathetic innervation and activation in BAT are also weakened accordingly(Fig. 3). With the understanding of obesity in western medicine and its influence on human metabolism, increasingly studies have found related targets and influencing factors, such as PPARγ, PRDM16, and other factors related to BAT production and development, as well as other targets related to fat transformation(Figure 3).

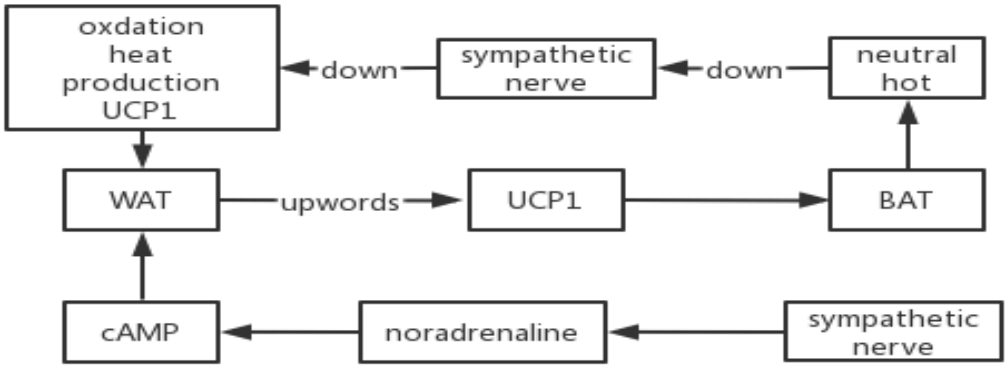

Figure 3. The translate of BAT and WAT

Mai[22] et al. found that Src family kinase-specific inhibitors PP1 and PP2 can promote the differentiation and generation of brown fat and activate UCP1 to induce WAT Browning. Adilson[21] et al. selectively induced fatty acid synthase in deficient mature mouse adipocytes to block the synthesis of new fatty acids in adipocytes, which could enhance the sympathetic inregulation and browning of WAT and improve systemic glucose metabolism, suggesting that the synthesis of new fatty acids may be related to the control of local sympathetic nerve activity in adipose tissue. Huang et al. [26] showed that dietary caloric restriction in mice can significantly improve the body weight, impair glucose metabolism and insulin resistance of mice, and promote the expression of thermogenic gene UCP1[10-11].

3. Understanding of Obesity in Traditional Chinese Medicine and Its Relationship with Spleen and Kidney

3.1. Understanding of Obesity in Traditional Chinese Medicine

Traditional Chinese medicine as early as in Huangdi neijing, which recorded obesity related diseases, which put forward more than "number of feed and fertilizer", it can also caused excess energy intake stored in WAT fat in western medicine, in the "element asked for evaluation of the actual situation of the proposed" who put away despair illusion of servant, hemiplegia impotent jue, inverse gas ManFa, fat people, is the disease of the sorghum ", despair an illusion of elimination is the medicine of diabetes[12], It can be seen that Chinese medicine has long recognized that obesity

can affect human metabolism and then lead to a series of diseases. The ancients believed that obese people were mostly phlegm dampness system, which was closely related to the spleen. Lingshu ·Twenty-five Persons of Yin and Yang recorded that "Earth-shaped people.. He is a man, yellow, with a round face, a big head, beautiful back and shoulders, a big belly, a beautiful shin, small hands and feet, and fleshy..[13]" The spleen belongs to the soil, and the records of the soil people have typical characteristics of obesity, which shows that obesity is closely related to the spleen. "The Complete Book of Jingyue" put forward that "fat people mostly have Qi deficiency" and "Yin sheng in Yang, more wet and more stagnant"; Ye Tianshi pointed out in "Guide to Clinical Medical Cases" that "worry about Qi deficiency and Yang"; Zhu Danxi believed that fat people are mostly characterized by Qi deficiency and phlegm dampness, and the kidney plays an important role in regulating the Yin and Yang of human qi machinery[14].

It can be seen that in the understanding of traditional Chinese medicine, the causes of obesity are mainly concentrated in Qi deficiency, Yang deficiency, phlegm dampness and so on, and there is an inseparable relationship with the spleen and kidney[15]. And the understanding of polycystic ovary syndrome of traditional Chinese medicine is also thought that its mainly phlegmy, wet spleen and kidney, spleen qi activity in humans, liquid water plays an important role in the regulation of metabolism, kidney in the human body balance of Yin and Yang as well as fluid metabolism plays an important role, so the disorder of spleen and kidney is human body metabolic disorders and obesity, the important cause of polycystic ovary syndrome, In the treatment of these diseases, more attention is paid to the regulation of spleen and kidney(Figure 4).

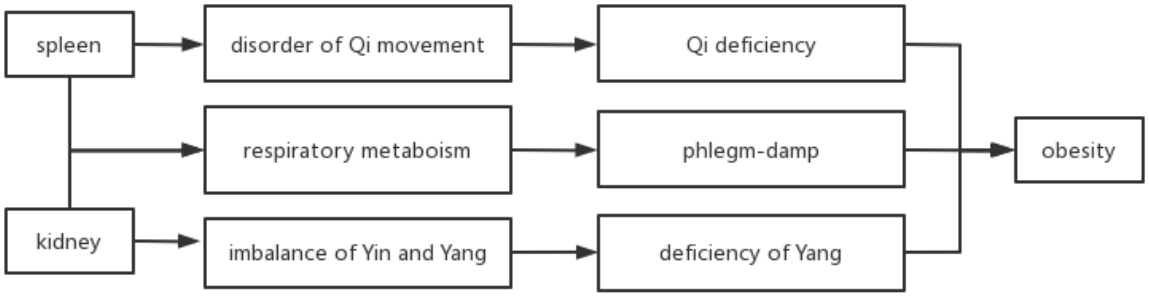

Figure 4. Pathogenesis of obesity in TCM

3.2. The Relationship between Obesity and Spleen

Splenic primary operation, and the main performance in the transport of food and water, nutrients, the human body to digest food and lose cloth of important organs, lift cycle, hub, spleen dysfunction nutrients cannot lose cloth, retained in the local storage function of this is the same in western medicine mainly WAT much less and generate heat dissipation is given priority to BAT(Table 1). "Plain question ·Strange disease" records "five taste entrances, hidden in the stomach, spleen for its Qi body fluid in the spleen, so that the population Can. This fatness is the result of which the man will eat luscious and fat food[16]. Fertilizer is an internal heat, sweet is in full, so the gas overflow into thirsting disorder ", puts forward the concept of despair, illusion of spleen, despair, illusion of "a" is hot, spleen dislikes dry wet, long taste of the food is sweet damp and hot accumulate spleen, spleen health loss affect water metabolism and qi activity lifting, condensed into phlegm, grease, hair as despair an illusion of the spleen, which can be converted into diabetes. Wang Wenyan et al. [2] believe that insulin-resistant obesity is due to metabolic disorders caused by stomach strength and spleen weakness, stomach heat, and spleen deficiency, and advocate the use of Banxia Xiexin Decoction to open bitterness, relieve the stomach and replenish the spleen. Chen Haiyang [6] found that humidification and spleen-strengthening drugs

ranked first through data mining of TCM medication rules for obesity. Professor Ren Qingling [12], based on "The disease of Eryang rejuvenates the heart and spleen", has achieved a significant therapeutic effects in the treatment of obese polycystic ovary syndrome by using such methods as clearing the heart and nourishing the blood, invigorating the spleen and nourishing the Yin, calming the heart and calming the mind, and strengthening the spleen and eliminating phlegm[17].

Spleen in the orifices such as the mouth, pivot, the degree of arteries and veins "record" temper in the mouth, spleen, and mouth can know the grain yi ", not of diet, irregular meals, or overeating wine meat fat to spleen and stomach weakness, spleen health delivery, appetite is impaired, spleen and stomach are closely associated with water, instead of traditional Chinese medicine also think, rice, wheat, millet, grain for invigorating qi spleen yi has significant role in the temperature. Chinese medicine has the concept of food therapy, and many medicines in Chinese medicine can also be used as the same source of medicine and food[18-19], such as hawthorn, malt, yam, etc., have a significant effect on strengthening and protecting the spleen and stomach. Similarly, modern medical studies have found that rutin (buckwheat), phytol (wheat), resveratrol (grape), and capsaicin (pepper) in grains, vegetables and fruits [17] all play an important role in promoting the browning of white fat. Therefore, starting from the aspects of diet and daily life, it is also important to maintain the normal function of the spleen and stomach to have a regular diet and daily life[20].

3.3. The Relationship between Obesity and Kidney

Kidney accumulates essence, serves as the main water source, and kidney Qi is involved in water and liquid metabolism of the body. If kidney qi is insufficient, water will stop accumulating and the phlegm will eventually become wet, which is an important pathological factor of obesity [21]. The Yin and Yang of kidney essence can stimulate the function of viscera (Table 1). This is the same as obese patients have too much WAT storage but less BAT based on consumption and heat production[22]. Meanwhile, obese patients often show kidney damage such as proteinuria, which is collectively named obesity-related glomerulopathy (Bariatric -related glomerulopathy, ORG). Think its and metabolic disorders caused by obesity, insulin resistance causes kidney pedant dynamics, renin angiotensin system disorders related to obesity and a kind of secondary focal segmental glomerular sclerosis, namely correlation glomerular disease, obesity and the risk of the disease has increased with the increase of the number of fat is on the rise, is also closely associated with kidney medicine understanding of obesity[23-24].

Kidney Qi is also divided into Yin and Yang, and Yang Qi has the function of warming, promoting, exciting, and dispersing. Therefore, the lack of kidney Yang Qi also lacks chemical generation, which makes the stored energy of the body unable to be distributed and utilized, resulting in disease[25]. Diabetes is often complicated by kidney-related diseases in Western medicine. Lingshu Benzang recorded that "Kidney is brittle, have good diseases". It can be seen that Chinese medicine has long recognized that human metabolic diseases are closely related to kidney, and some scholars believe that obesity, diabetes, hypertension, and other common metabolism-related diseases are mainly kidney deficiency[26]. Kidney main, congenital, spleen main acquired, kidney Yang deficiency, not warm, Mingmen fire failure, Qi and blood operation is not smooth, not to fill the viscera, or lack of temper, insufficient transport and basic, can cause spleen kidney deficiency[27]. Unpaid by the method of tonifying spleen kidney in the treatment of super quality and obese polycystic ovary syndrome, the control group was given conventional western medicine treatment, the experimental group in the control group given on the basis of the method of tonifying spleen kidney[28-29], the final result of the experimental group on the conversion rate and hormone were better than that in the control group, xiao-min deng USES three kernel soup treatment of obese type 2 diabetes mellitus and diabetic nephropathy, After treatment,

TCM symptom score, fasting blood glucose, 2 h postprandial blood glucose, glycosylated hemoglobin and urinary protein of the experimental group were significantly improved compared with before treatment, and were better than the control group. It can be seen that the clinical treatment of obesity and its metabolic syndrome from the perspective of spleen and kidney has a significant effect.

Table 1. The role of spleen and kidney in obesity

Viscera	Function
Spleen	Transport water liquid
	Transport food
Kidney	Kidney essence
	Kidneys water
	Balance Yin and Yang

4. Conclusion

With the improvement of modern living standards, obesity patients also increase, and excessive obesity is closely related to human metabolism, immune inflammatory response, often induced diabetes, and cardiovascular diseases. Polycystic ovary syndrome clinical cache is mostly on obesity and metabolic disorders, and clinical practice showed that diet plays an important role to the improvement of the symptoms, from the angle of obesity treatment has become a hot point of view, Chinese medicine understanding of obesity, spleen and kidney and viscera function, liquid water is closely related to metabolism, so to regulate spleen and kidney[30-31], The Angle of tonifying the kidney and spleen for the treatment of obesity is also of great significance in the treatment of polycystic ovary syndrome. With more clinical practice, application and improvement, it is believed that this angle will play a greater role in the treatment of gynecological diseases in the future.

Funding

There is no fund for this paper.

Data Availability

No new data is used or generated

Conflict of Interest

There is no conflict of interest between the authors.

References

[1] Zhang, L.L., Su, X.P., Zhu, L.H., Zhang, X.P., Li, L.R. (2021) Obesity and Health Related Research Progress of Traditional Chinese Medicine. The World of Traditional Chinese Medicine, 1-13.

[2] Wang, W.Y., Chen, R., Liang, F.X. Discussion on the Theory of Banxia Xiexin Decoction in Treating Insulin Resistant Obesity. World of Traditional Chinese Medicine, 201, 16(20):3054-3057. DOI:10.3969/j.issn.1673-7202.2021.20.016

[3] Yu, Z.W., Lu, M.J., Wang, Y.T., Xu, B. Mechanism of Bidirectional Regulation between Brown Adipose Tissue and Sympathetic Nervous System. Life Science, 201, 33(10):1197-1205.

[4] Wang, H.N., Qi, Z., Li, X.L., Xiang, J.Z. Advances in Bioactive Substances and Mechanisms That Regulate the Browning of White Fat. Advances in Physiological Science, 201, 52(04):317-322. DOI:10.3969/j.issn.0559-7765.2021.04.015

[5] Wibmer, A.G., Becher, T., Eljalby, M., Crane, A., Andrieu, P.C., Jiang, C.S., Vaughan, R., Schoder, H., Cohen, P. (2021) Brown Adipose Tissue is Associated with Healthier Body Fat Distribution and Metabolic Benefits Independent of Regional Adiposity. Cell Reports Medicine.

[6] Chen, H.Y., Zhou, H.M., Hu, X. Study on Medication Regularity of TCM in the Treatment of Obesity Based on Data Mining. Gansu Science and Technology, 201, 37(12):122-124+63. DOI:10.3969/j.issn.1000-0952.2021.12.040

[7] Yue, H.Q, Zhou, H.D. Study on the Role of White Adipose Tissue in Different Types of Obesity and Metabolic Status. Chinese Journal of Clinical Pathology, 201, 41(06):1448-1453.

[8] Yuko, O.O., Saito, M. (2021) Brown Fat as a Regulator of Systemic Metabolism beyond Thermogenesis. Diabetes & metabolism journal (6). DOI:10.4093/DMJ.2020.0291

*[9] Kuchler, J.C., Siqueira, B.S., Ceglarek, V.M., Chasko, F.V., Moura, I.C., Sczepanhak, B.F., Vettorazzi, J.F., Balbo, S.L., Grassiolli, S. (2021) The Vagus Nerve and Spleen: Influence on White Adipose Mass and Histology of Obese and Non-obese Rats
. Journal of Frontiers in Physiology, 12, 751. DOI:10.3389/fphys.2021.672027*

[10] Zhao, Q.Y, Yi, X.Y, Wang, Z.H. (2021) Meta-Analysis of the Relationship between Abdominal Obesity and Diabetic Kidney Disease in Type 2 Diabetic Patients. Obesity facts, 14(4), 338-345. https://doi.org/10.37155/2717-5669-0203-2

[11] Zeng, X.L. (2021) Professor HE Xiaohui's Theoretical Research and Clinical Application of "Spleen Hiding Camp" in Neijing. Jiangxi University of Traditional Chinese Medicine.

[12] Fang, B., Ren, Q.L. Ren Qing-ling's treatment of obese polycystic ovary Syndrome based on "Two Yang's disease develops the heart and spleen". Hubei Journal of Traditional Chinese Medicine, 201, 43(05):33-36.

[13] Song, C.M., there were night and sun, Fu Yan, Zhang Jin. Progress of TCM research on obesity. Modern Chinese Medicine, 201, 41(03):6-9.

[14] Zhang, Z.Y. Research Progress of the Protective Effect of Phospholipid on Obesity-Induced Kidney Injury. Journal of Food Safety and Quality Inspection, 201, 12(08):3147-3152.

[15] Yim, H.E., Yoo, K.H. Obesity and Chronic Kidney Disease: Prevalence, Mechanism, and Management. Clinical and experimental paediatrics. 2021. DOI:10.3345/cep.2021.00108

[16] Li, J.X., Zhang, Y., Li, B., Hao, Y.W., Yin, F., Yu, J.R. Study on the Pathogenesis of "Overwork And Obesity" From The Three Viscera Of Liver, Spleen And Kidney. Global Journal of Traditional Chinese Medicine, 201, 14(04):624-626.

[17] Zhang, K.L., Sun, J., Fan, M.C., Qian, H.F., Ying, H., Li, Y., Wang, L. (2021) Functional Ingredients Present in Whole-Grain Foods as Therapeutic Tools to Counteract Obesity: Effects on Brown And White Adipose Tissues. Trends in Food Science & Technology, 109.

[18] Li, Y., Cheng, N., Xu, J. Clinical Effect of Tonifying Spleen and Kidney In The Treatment of Hypermass and Obesity Polycystic Ovarian Syndrome and Its Influence on Glucose and Lipid Metabolism, Polycystic Changes of Ovary And Uterine Receptivity. Hebei Journal of Traditional Chinese Medicine, 20, 42(10):1476-1481. DOI:10.3969/j.issn.1002-2619.2020.10.008

[19] Johann, K., Cremer, A.L., Fischer, A.W., Heine, M., & Mittag, J. (2019). Thyroid-Hormone-Induced Browning of White Adipose Tissue Does not Contribute to Thermogenesis and Glucose Consumption. Cell Reports, 27(11), 3385-3400.e3. DOI:10.1016/j.celrep.2019.05.054

[20] Deng, X.M., Xie, J.Y., Wang, Z.G., Tang, A.H., Chen, S.H., Chen, L. (2018) Clinical Observation of Sanren Decoction in Treating Obese Type 2 Diabetes Mellitus Complicated with

Diabetic Nephropathy. Tianjin Traditional Chinese Medicine, 35(07):491-494. DOI:10.11656/j.issn.1672-1519.2018.07.04

[21] Adilson, G., David, J.P., Felipe, H., Alexander, H. Bedard, E.H., Mark, K., Kamal, R., Donald, A.M., Michael, P.C. (2018) Neuronal Modulation of Brown Adipose Activity Through Perturbation of White Adipocyte Lipogenesis. Journal of Molecular Metabolism, 16, 116-125. DOI:10.1016/j.molmet.2018.06.014

[22] Usui, M., Uno, M., Nishida, E. (2016) Src Family Kinases Suppress Differentiation of Brown Adipocytes and Browning of White Adipocytes. Genes To Cells: Devoted To Molecular & Cellular Mechanisms, 21(4).

[23]Joanna, W., Barbara, J., Anna, K.C.O., Robert, C., Mariusz, M., Micha, C.Z., Odzimierz, B., Piotr, R. (2014) Innervation Pattern of Polycystic Ovaries in the Women. Journal of Chemical Neuroanatomy, 21-62.

[24]Lo, K.Y.A., Sun, L. (2013) Turning WAT into BAT: A Review on Regulators Controlling the Browning of White Adipocytes. Bioscience Reports, 33(5). DOI:10.1016/j.jchemneu.2014.05.003

[25]Reyes, F.M., Fosdomenech, J., Serra, D., Herrero, L., SanchezInfantes, D. (2021) White Adipose Tissue Dysfunction in Obesity and Aging. Biochemical Pharmacology, 192.

[26] Huang, D., Zhang, Z., Dong, Z., Huang, J., Xu, G. (2021) Caloric Restriction and Roux-En-Y Gastric Bypass Promote White Adipose Tissue Browning in Mice. Journal of endocrinological investigation.

[27]Sunita, J.R., Balasaheb, B.G., Jaiprakash, B.R., Milind, H.P., Ravi, R.G., Suyog, S.J. (2013) Clinical Characteristics of Polycystic Ovary Syndrome in Indian Women. Indian Journal of Endocrinology and Metabolism, (1).

[28] Zhang, X., Lian, F. (2002) Research Progress on the Mechanism and Clinical Significance of Inflammatory Cytokines Interleukin-6, Tumor Necrosis Factor-A and Transforming Growth Factor-B1 in Polycystic Ovary Syndrome. Chinese Journal of Sex Science, 31(01):47-50.

[29] Jia, Y. J., Wang, Z.X., Wu, C.L., Wang, D.H. Correlation and Clinical Significance of Serum RBP-4, IL-1B and VEGF in Obese Patients with Polycystic Ovary Syndrome. Chinese Journal of Family Planning, 201, 29(09):1960-1962. DOI:10.3969/j.issn.1004-8189.2021.09.041

[30] Yin, X.Q., Hou, L., Song, X.J., Jin, L. (2017) The Relationship between Nerve Growth Factor and Polycystic Ovary Syndrome and Its Influence on Pregnancy Outcome. Clinical research in China, 30 (03): 382-384. DOI:CNKI:SUN:ZGCK.0.2017-03-030

[31] Chen, B.J., Cheng, L.N., Wang, Y.W., Shi, L.T., Chen, J.L., Li, L., Sun, X. X. (2009) Expression of Nerve Growth Factor and Its Receptor in Granulosa Cells and the Development Of Follicles In Patients With Polycystic Ovary Syndrome. Chinese Journal of Clinical Synthesis, (12):1314-1316.