

Original Research

Effects of an “Internet +” Multidisciplinary Management Model Oriented by Nurse Specialists on Obesity Combined with Polycystic Ovary Syndrome

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Academic Editor: Johannes Ott

Submitted: 6 January 2023 Revised: 28 February 2023 Accepted: 7 March 2023 Published: 12 June 2023

Abstract

Background: Polycystic ovary syndrome (PCOS) is the most common endocrine metabolic disease in women of reproductive age, and its treatment mainly relies on adjusting lifestyle and oral drug therapy. With the development of the Internet and shared economy, the “Internet + nursing services” model has become increasingly popular, is presently an essential component of the Health Wellness project and has a promising future. **Methods:** This study involved 100 gynecological outpatients with PCOS from the Foshan Maternal and Child Health Hospital. They were divided into a control (routine nursing) and an experimental (“Internet +” multidisciplinary management oriented by nurse specialists) group according to a predefined nursing scheme. Several indicators, such as rates of ovulation and pregnancy, body mass index (BMI), waistline, serum hormone levels, metabolic indicators and psychological status of patients, were compared between the two groups before and half a year after the nursing intervention. **Results:** Six months after the intervention, the experimental group had significantly higher ovulation and pregnancy rates than the control group (88.00% vs. 68.00%, 48.00% vs. 22.00%, $p < 0.05$). Additionally, the experimental group showed a significant decrease in BMI, waistline, serum hormone levels (*i.e.*, testosterone and luteinizing hormone [LH]) and homeostasis model assessment of insulin resistance (HOMA-IR) compared to the control group ($p < 0.05$). However, no obvious differences were observed in follicle-stimulating hormone (FSH) and fasting blood glucose (FBG) ($p > 0.05$) compared with the control group. Further, patients in the experimental group also displayed better psychological status, with a significant decrease in self-rating anxiety scale (SAS) scores and self-rating depression scale (SDS) half a year after intervention ($p < 0.05$). **Conclusions:** Interventions using the “Internet +” multidisciplinary management model oriented by nurse specialists not only effectively increased the rates of ovulation and pregnancy of PCOS patients but also significantly improved patients’ indicators such as BMI, waistline, serum hormone levels, metabolic indicators, and psychological status.

Keywords: Internet +; specialist; nurses; multidisciplinary; obesity; polycystic ovary syndrome; pregnancy

1. Introduction

Polycystic ovary syndrome (PCOS) is a common endocrine disorder in gynecological clinics, characterized by menstrual disorders, persistent anovulation, infertility and polycystic ovary, and about 75% of the patients are often accompanied by insulin resistance and obesity [1]. Previous studies showed that fat accumulation in obese PCOS patients could further exacerbate insulin resistance, thereby promoting the abnormal secretion of serum hormones in patients and increasing the risk of diabetic angiopathy [2]. As a result, enhancing the treatment of obese PCOS is of great significance.

Over the past decade, epidemiological studies have reported an alarming increase in the incidence of PCOS worldwide [3]. Despite extensive research on this condition, there is still a lack of systematic and standardized long-term management systems for these patients in China, which has resulted in the absence of an optimal all-round treatment PCOS protocol [4]. With the development of

Internet and mobile medical information management services, we propose a novel “Internet +” multidisciplinary management model led by specialized nurses using the WeChat (Tencent, Shenzhen, Guangdong, China) platform as continuity nursing outside hospital settings to address this issue. The proposed model was combined with multidisciplinary long-term management with the aim of promoting continuity interactions between patients and medical personnel.

In this study, we employed an “Internet +” multidisciplinary management model led by nurse specialists and utilized the Internet + mobile service platform information technology to remotely monitor and guide continuous nursing and assess their effects on obese PCOS patients.



2. Materials and Methods

2.1 Objects

From January 2021 to January 2022, obese PCOS patients who met the study criteria were screened from the gynecological outpatients of the Affiliated Foshan Maternity and Child Healthcare Hospital, Southern Medical University (Foshan, Guangdong, China). Using the random number table method, a qualified cohort comprising 100 patients was divided into a control and an experimental group in a 1:1 ratio. All the enrolled patients provided signed informed consent, and the study was approved by the Ethics Committee of the Affiliated Foshan Maternity and Child Healthcare Hospital, Southern Medical University. The age of the patients in the control group ranged from 22 to 32 years, with an average age of 26.91 ± 3.08 years and a mean body mass index (BMI) of 28.57 ± 1.34 . Comparatively, the age of patients from the experimental group ranged from 22 to 33 years, with an average age of 27.54 ± 3.06 years and a mean BMI of 28.69 ± 1.43 . We found no significant difference in the baseline information between the two groups, making experimental results obtained in the present study comparable.

2.2 Screening Criteria

The study inclusion criteria were: (1) women aged 20 to 40 years; (2) meeting the relevant standard of the 2018 International Evidence-based Guidelines for PCOS [5]; (3) $\text{BMI} \geq 24 \text{ kg/m}^2$; (4) could use mobile network phone and willing to accept a follow-up visit; (5) without any contraceptive use for more than one year and no successful conception with normal sexual life. The exclusion criteria were: (1) had taken medicines related to ovulation induction, androgen reduction, lipid-lowering or weight loss in the past 3 months that may have an impact on the study; (2) PCOS patients associated with other organic lesions such as hysterosmyoma, endometrial polyps, uterine malformations, and intrauterine adhesion; (3) hysteroscopy showed ≥ 5 CD138 positive plasma cells; (4) genital tract infections such as mycoplasma, chlamydia or gonorrhea; (5) had cancer-related or acute diabetic complications with unstable conditions; (6) disabilities in daily living and activities; and (7) patient's spouse diagnosed with chromosomal abnormalities, asthenozoospermia, oligospermia or azoospermia diagnosed.

2.3 Study Protocol

Based on the patients' complaints and needs, the control group was given traditional treatment and routine nursing, such as prescribing examinations and drugs, simple education on disease-related knowledge by medical workers, instructions for diet and exercise, and notifications of medication precautions.

Comparatively, patients in the experimental group were treated using the "Internet +" multidisciplinary management model oriented by nurse specialists while also re-

ceiving drug treatment. The specific management contents included: (1) establishment of a gynecological endocrine integrated management team, such as implementing a gynecological endocrinology consultation service consisting of 5 gynecological endocrinologists, 3 gynecological specialist nurses, 2 nutrition specialist nurses, and 1 psychological specialist nurse; (2) establishment of a multidisciplinary collaborative joint management model oriented by nurse specialists: (i) the gynecological endocrinologist diagnosed the condition according to the patient's medical history, provided clear treatment objectives, and opened menstrual health management archives; (ii) the gynaecological specialist nurses established a personal and exclusive health records for the PCOS patients; (iii) one-to-one disease education and sport-related guidance for gynecological specialized nurses: awareness of the pathogenesis, etiologies, recent symptoms and long-term complications of PCOS, and explaining the treatment plan according to various inspection reports and individual needs; one-to-one exercise guidance: make exercise plans according to the age and occupation of the patient; one-to-one medication guidance: explaining the precautions and cycle of medication, emphasize that medication should not be missed, and the remedial measures for missed medication to relieve patients' concerns about hormone drugs; one-to-one response to the patient's questions during the consultation process; (iv) the specialist nurse system in the nutrition department conducted one-to-one diet intervention according to the patient's BMI and body fat analysis report, and formulated a diet according to the dietary guidelines for diabetic patients and their living habits; The blood glucose production index table of commonly used foods was distributed to patients to guide the selection and collocation of foods with low blood glucose production index; (v) the psychological specialist nurse assessed the patient's psychological state according to the patient's anxiety scale, depression scale and Anderson symptom inventory, listened to the patient's thoughts on the disease, established mental health files, and offered timely guidance and persuasion based on their psychological problems. (3) Follow-up interventions and visits were performed with the help of an internet platform: (i) For patients with weight loss needs, nurses guided them to download the "Knott Weight Management APP" (Zhejiang Knott health science Co., LTD., Hangzhou, Zhejiang, China) and monitored the daily conditions of the patient's weight, diet, exercise and metabolic consumption. If the indicators on the day were not up to standard, the dietitian conducted telephonic guidance and detailed inquiry to supervise the patients to establish a good lifestyle. (ii) The nurse informed the patients to log onto the hospital's internet during the treatment process and provided a 24-hour consultation system to answer the patient's questions at any time. (iii) Scientific knowledge about gynecological endocrine was regularly published on the WeChat official account of the Foshan Maternal and Child Health Gynecol-

ogy. The patients were guided to subscribe to the WeChat official account and read the educational health information published. (iv) Follow-up visits were performed 1 month, 3 months and 6 months after archiving. The purpose of the follow-up was to assess patients' compliance with the current long-term management plan, educate the importance of long-term management, remind them to perform subsequent regular visits, and record the patient's long-term follow-up and management.

2.4 Observational Index

Follow-up visits and information collection were conducted before and six months after the intervention. The following indicators were assessed: BMI, waistline, rates of ovulation and pregnancy, serum testosterone (T), follicle-stimulating hormone (FSH), luteinizing hormone (LH), indicators related to glucose metabolisms such as fasting blood glucose (FBG) and homeostasis model assessment of insulin resistance (HOMA-IR), and psychological status of patients.

2.5 Statistics

The SPSS v25.0 (IBM Corp., Armonk, NY, USA) statistical software was used for statistical analysis. Quantitative data that met or almost met the Gaussian distribution are represented as mean $\pm$ standard deviation (mean $\pm$ SD). The student *t*-test was applied to compare two independent samples meeting the Gaussian distribution. Pre- and post-treatment comparisons within the same group were performed using the paired *t*-test. Enumeration data are reported as proportions, and differences between two or more occurrence rates or structural ratios were compared using the Chi-square test. A *p* value < 0.05 was considered statistically significant.

3. Results

3.1 Comparisons of Ovulation and Pregnancy Rates

After the six-month intervention, 34 patients were found to have ovulated, showing an ovulation rate of 68.00% in the control group, while that of the experimental group was 44 and 88.00%, respectively. As for pregnancy rate, 11 and 24 patients successfully conceived, accounting for 22.00% and 48% of patients in the control and experimental groups, respectively. Further, patients from the experimental group had higher ovulation and pregnancy rates than the control group after intervention (χ^2 value = 5.828 and 7.429; *p* value = 0.016 and 0.006).

3.2 Comparisons of BMI and Waistline

The baseline characteristics of the two groups were comparable, as indicated by the absence of significant differences in BMI and waist circumference before intervention. Subsequently, after six months of intervention, both groups showed a significant decrease in BMI (t-control and test group values = 7.608 and 20.702, respectively, *p* <

0.05) and waist circumference (t-control and test group values = 2.939 and 5.052, respectively, *p* < 0.05) within the same group compared to before the intervention. Notably, the test group exhibited significantly lower BMI and waist circumference than the control group after six months of intervention (*p* < 0.05) (Table 1).

3.3 Comparisons of Serum Hormone Levels

After six months of intervention, both control and test groups showed significant decreases in serum levels of T (t-control and test group values = 3.087 and 11.345, *p* < 0.05), while the FSH levels did not significantly change (t-control and test group values = 0.411 and 0.436, *p* > 0.05). The LH levels were significantly decreased in both groups (t-control and test group values = 3.121 and 6.923, *p* < 0.05). After six months of intervention, there was no significant difference in FSH levels between the control group and the experimental group. Furthermore, the test group exhibited significantly lower levels of both T and LH levels than the control group (*p* < 0.05) (Table 1).

3.4 Comparisons of Glucose Metabolism

The FBG and HOMA-IR of the patients were similar between the control group and the test group before the intervention. The intra-group comparison showed that the FBG levels were significantly lower in both groups after six months of intervention (t-control and test group values = 5.469 and 3.093, respectively, *p* < 0.05). The HOMA-IR levels were also significantly lower (t-control and test group values = 2.137 and 7.284, respectively, *p* < 0.05), while the FBG levels were not significantly different between the groups after six months of intervention. In addition, the HOMA-IR in the test group was significantly lower than the control group (*p* < 0.05) (Table 1).

3.5 Comparisons of Psychological Status

We found no significant difference in self-rating anxiety scale (SAS) and self-rating depression scale (SDS) scores between the control and experimental groups before the intervention. However, after the six-month intervention, both the control and experimental groups exhibited significant decreases in SAS (t-control and test group SAS values = 4.187 and 9.720) and SDS (t-control and test group SDS values = 4.529 and 8.570, *p* < 0.05). Additionally, the experimental group had significantly decreased SAS (44.34 $\pm$ 6.56) and SDS (43.69 $\pm$ 5.61) scores than the control group (SAS, 52.10 $\pm$ 6.84; SDS, 49.45 $\pm$ 5.65) after the six-month intervention (*p* < 0.05) (Table 1).

4. Discussion

According to epidemiological statistics, the incidence of infertility is about 15% in China, and nearly 70% to 80% of patients with ovulatory infertility are associated with PCOS [6], which has an incidence rate ranging between 5% to 10% worldwide [7]. The pathogenesis of PCOS is multi-

Table 1. Comparisons of BMI, waistline, serum hormone levels, glucose metabolism and psychological status between groups ($\bar{x} \pm S$).

Variables	Control group (n = 50)		t value/ p value	Experimental group (n = 50)		t value/ p value	t ₁ value/ p value
	Before intervention	Six months after intervention		Before intervention	Six months after intervention		
BMI (kg/m ²)	28.57 $\pm$ 1.34	26.19 $\pm$ 1.76	7.608/0.000	28.69 $\pm$ 1.43	23.39 $\pm$ 1.11	20.702/0.000	9.552/0.000
Waistline	85.26 $\pm$ 5.21	82.46 $\pm$ 4.27	2.939/0.004	84.87 $\pm$ 5.26	80.17 $\pm$ 3.95	5.052/0.000	2.784/0.006
T (nmol/L)	1.99 $\pm$ 0.39	1.73 $\pm$ 0.45	3.087/0.003	1.88 $\pm$ 0.44	1.06 $\pm$ 0.26	11.345/0.000	9.120/0.000
FSH (IU/L)	4.92 $\pm$ 0.89	4.85 $\pm$ 0.81	0.411/0.682	4.79 $\pm$ 1.12	4.67 $\pm$ 1.59	0.436/0.664	0.721/0.473
LH (IU/L)	11.61 $\pm$ 3.28	9.60 $\pm$ 3.16	3.121/0.002	11.66 $\pm$ 3.14	7.65 $\pm$ 2.63	6.923/0.000	3.336/0.001
FBG (mmol/L)	5.41 $\pm$ 0.58	4.89 $\pm$ 0.34	5.469/0.000	5.22 $\pm$ 0.78	4.81 $\pm$ 0.52	3.093/0.003	0.811/0.419
HOMA-IR	5.11 $\pm$ 0.87	4.78 $\pm$ 0.66	2.137/0.035	5.26 $\pm$ 0.86	4.05 $\pm$ 0.80	7.284/0.000	5.066/0.000
SAS	58.70 $\pm$ 8.80	52.10 $\pm$ 6.84	4.187/0.000	59.10 $\pm$ 8.50	44.34 $\pm$ 6.56	9.720/0.000	5.791/0.000
SDS	55.00 $\pm$ 6.57	49.45 $\pm$ 5.65	4.529/0.000	53.34 $\pm$ 5.65	43.69 $\pm$ 5.61	8.570/0.000	5.119/0.000

Note: t represents the comparison of indicators before and after intervention within the same group, while t₁ represents the comparison of indicators after intervention between the two groups.

BMI, Body mass index; T, testosterone; FSH, Follicle-stimulating hormone; LH, Luteinizing hormone; FBG, Fasting blood glucose; HOMA-IR, Homeostasis model assessment of insulin resistance; SAS, Self-rating anxiety scale score; SDS, Self-rating depression scale score.

factorial, involving not only hereditary and familial factors but also environmental and lifestyle factors such as work-related stress. PCOS is often associated with increased androgen secretion, leading to infertility and negative impacts on appearances, such as hirsutism and alopecia. In addition, insulin resistance associated with PCOS can increase the risk of developing diabetes mellitus and obesity, further increasing the risks of miscarriage and premature delivery in obese patients. These factors can eventually lead to anxiety, depression and other stressful negative emotions, particularly in those of childbearing age. Therefore, it is crucial to consider mental health as an essential component of the treatment of obese PCOS patients [8]. Lifestyle modification and oral medications are the mainstay of treatment for PCOS. Lifestyle modification is primarily achieved through diet, exercise and behavioral interventions, whereas pharmacotherapy consists of modulation of the menstrual cycle, reduction of blood androgen levels, and improvement of insulin resistance, among others. In addition, appropriate myo-inositol supplementation is also important as an adjunctive conditioning feature in the management of PCOS [9]. Relevant guidelines indicate the persistent impacts of obese PCOS on female patients and emphasize the necessity of introducing chronic disease management concepts during follow-up treatment, indicating that attention should not only be paid to the conditioning of infertility and menstruation but also to cardiovascular and metabolic diseases [10].

With the continuous deepening of medical research, various nursing solutions have emerged in the clinics, such as the 5A nursing mode, refined management, etc., with different efficacies reported in the clinical care of PCOS [11,12]. The multidisciplinary collaboration model is a comprehensive nursing model newly developed in China in recent years and presently remains at the exploratory stage.

However, the management models vary greatly depending on the type of disease [13,14]. In this study, we adopted an “Internet +” multidisciplinary management model oriented by nurse specialists based on the internet technology and health management platform. This model comprised a professional team responsible for information collection, information tracking and guidance for healthy diet and exercise, making high-quality medical care accessible to local patients in Foshan.

We also found that compared with the control group, the experimental group significantly decreased BMI and waist circumference, and significantly increased ovulation and pregnancy rates in patients after 6 months of intervention. Also, the levels of androgen and the status of glucose metabolism were both significantly improved. We believed that these might be linked to scientific instructions for diet and physical activity that helped improve the living habits of the patients [15] and boosted the patients’ compliance and self-management ability through supervision and guidance from the data platform. Moreover, the internet online management model also facilitated timely and effective patient communications, whereby questions from patients could be quickly replied and health awareness could be executed, thus making the patients feel well-cared by the medical staff, which also helped motivate them to face and manage the disease more positively. Notably, the intervention also significantly decreased anxiety and depression scores, indicating improved mental health in patients. Overall, these findings suggest that the internet-based multidisciplinary management model may be an effective and promising approach for managing PCOS.

Due to the limitations of the sample size and the study duration, we were only able to investigate and verify the impact of the intervention on the ovulation rate, pregnancy rate, serum hormone level and psychological status of the

patients in this study. However, their underlying mechanism of action and effects on other indicators remain unknown, urging the need for a larger cohort size, extended study durations, and further exploration of additional research contents.

5. Conclusions

In conclusion, the “Internet +” multidisciplinary management model oriented by nurse specialists is an innovative approach that builds on traditional nursing models and leverages internet-based technology to improve healthcare outcomes. This model demonstrated significant effects in treating obese PCOS patients, reflecting the improvement in patients’ BMI, waistline, endocrine serum parameters, glucose metabolism, psychological status and ovulation and pregnancy rates. Besides, considering that the frequency of hospital visits was largely reduced during the pandemic period, the application of this model could enhance the working efficiency of medical staff, indicating the promising market prospect of our proposed “Internet +” multidisciplinary management model.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article.

Author Contributions

Conceptualization, Methodology, and Writing - Original Draft was written by YO and LW; Formal analysis, Resources, and Investigation were obtained and performed by LL; Formal analysis, Visualization and Data Curation were conducted by XY; Project administration, Supervision, and Validation were performed by YC; Validation, Supervision and Writing - Review & Editing were performed by HY. All authors contributed to editorial changes in the manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Ethics Committee of Affiliated Foshan Maternity and Child Healthcare Hospital, Southern Medical University (Approval No. 2021107). Written informed consent was obtained from a legally authorized representative(s) for anonymized patient information to be published in this article.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

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