Effect of Pender's Health Promotion Model in Improving the Nutritional Behavior among Women with Polycystic Ovary associated Insulin Resistance

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Abstract

Background: One of the main issues and a prevalent, crippling metabolic condition affecting females who are pregnant is insulin resistance linked to polycystic ovarian syndrome. Therefore, one of the most important management strategies is to improve the dietary habits of the impacted females. **Aim:** The study aimed to examine the effect of Pender's health promotion model on improving the nutritional behavior among women with polycystic ovaries associated insulin resistance. **Design:** One group, time series (pre-post and follow-up), quasi-experimental research approach was employed. **Study Setting**: This study was carried out in the Obstetrics & Gynecology Outpatient Clinic in the Qaliobya Governorate of Egypt, which is connected to Benha University Hospitals. **Sample:** A purposive sample of fifty-five females having a medical diagnosis of insulin resistance linked to polycystic ovaries. **Tools:** A structured interviewing questionnaire, females' knowledge questionnaire, Pender's health promotion model, and surveys on nutritional behavior and food patterns were the four instruments that were employed. **Results:** The mean scores of the females under study varied significantly in terms of body mass index , knowledge, Pender's health promotion model components, nutritional behavior, and dietary pattern before, during, and after the intervention. The study females' total body mass index score before, during, and after the intervention periods showed a statistically significant negative connection with their overall nutritional behavior score. **Conclusion:** Enhancing females' understanding, nutritional behavior, and dietary patterns, as well as lowering body mass index over the course of program phases, are all benefits of using Pender's Health Promotion Model. Consequently, the study hypothesis was approved **Recommendations:** Application of an educational package based on Pender's health promotion model about risk factors and preventive measures of polycystic ovarian syndrome associated insulin resistance among high risk group women.

Key words: Insulin Resistance, Nutritional Behavior, Pender's Health Promotion Model, Polycystic Ovary.

Introduction:

A condition known as insulin resistance (IR) occurs when cells do not respond to insulin as well as they should, even when their insulin levels are normal or increased. This leads to an elevated blood sugar level. The development of PCOS may result from hyperinsulinemia's disruption of the hypothalamus-pituitary-ovary axis. The ovaries overproduce androgens as a result of it because it increases the pulsatile production of hypothalamic gonadotropin-releasing hormone (GnRH), which enhances the ratio of LH to FSH (***Zhao, et al.,2023)***. About 80% of obese females with PCOS and 30% to 40% of lean females have IR ***(Anwar, et al.,2023).***

For a long time, PCOS was referred to as Stein-Leventhal syndrome, or hyperandrogenic anovulation, after the disorder was discovered by physicians Stein and Leventhal in 1935. PCOS is a collection of symptoms caused by a hormonal imbalance in females. An ovary with 12 or more follicles, each 2 to 9 mm in diameter, and an increased ovarian volume are characteristics of PCOS morphology. The most common and complex endocrine

disorder affecting females in their reproductive years is PCOS (***Maqbool, et al.,2019)***.

Hormonal imbalance, chronic low-grade inflammation, insulin resistance, and hyperandrogenism are the main pathophysiological factors of PCOS. These variables increase the risk of related diseases like type II diabetes and endometrial cancer and impede the process of folliculogenesis. The overproduction of testosterone and other androgen hormones by the ovaries leads to hormonal imbalances. The anterior pituitary gland's excessive production of pulsatile LH or females with hyperinsulinemia, or ovaries that are extremely sensitive to these stimuli, could be the cause of this (***Taghizadeh, et al.,2023*)**.

The symptoms of IR and PCOS include irregular or nonexistent menstruation, heavy periods, excessive body and facial hair, acne, pelvic pain, pregnancy problems, and patches of thicker, darker, velvety skin. Type 2 diabetes, obesity, sleep apnea, heart disease, mental disorders, endometrial cancer, hypertension, dyslipidemia, hyperinsulinemia, and infertility are additional health issues linked to PCOS. Obesity, hyperandrogenism, and irregular menstruation are the three primary classic symptoms ***(Shukla, and Verma, 2021). (Shukla, and Verma, 2021).***

Overweight or obesity is defined as a BMI (BMI) of 25 kg/m2 or more, and it is a major concern for females with PCOS and insulin resistance. Overweight or obese females make up half of PCOS patients. The most common metabolic characteristic of PCOS is IR and compensatory hyperinsulinemia, which affects 35–80% of females with PCOS ***(Rahmatnezhad, et al.,2023)***. In contrast to being a cause of PCOS, obesity may be a moderating factor. Correcting dietary behavior is advised for PCOS-associated IR since obesity exacerbates the condition by increasing insulin resistance, hyperinsulinemia, adipogenesis, and decreasing lipolysis ***(Louwers& Laven, 2020).***

According to the Rotterdam criteria, PCOS cannot be diagnosed unless there is polycystic ovarian morphology, clinical and biochemical hyperandrogenism, and ovulatory dysfunction. Based on combinations of these three traditional symptoms, PCOS females can be classified into four primary phenotypes: Hyperandrogenism plus polycystic ovaries plus oligomenorrhea (A), oligomenorrhea plus PCO (B), hyperandrogenism plus oligomenorrhea (C), and oligomenorrhea plus PCO (D) ***(Mansour, et al.,2023).***

The Health Promotion Model pinpoints the variables that affect health-related behaviors, namely those pertaining to nutrition. Pender's health promotion model (HPM) is an explanatory model of health behavior that highlights how expectations affect behavior. It was initially developed in 1982 and revised in 1996 ***(Habibzadeh, et al., 2021).*** One of the most popular models for identifying and altering unhealthy behaviors and promoting health is Pender's HPM. Perceived advantages, obstacles, self-efficacy, behavioral emotions, situational and interpersonal influences, and dedication to action are all included in Pender's model. Additionally, it is thought to be one of the best indicators of dietary and self-care practices that can help control IR associated with PCOS ***(Chen & Hsieh, 2021).***

The whole of females' planned, impulsive, or habitual food-gathering, cooking, eating, and post-processing behaviors is known as nutritional behavior (***Dötsch, et al.,2023).*** The Mediterranean diet, low-carbohydrate diet, pulse-based diet, ketogenic diet, low-glycemic index diet, low-dairy/low-starch diet, vegetarian diet, and intermittent fasting are among the dietary practices that are advised for PCOS.

The time-restricted feeding (TORF) diet may aid in weight loss for anovulatory PCOS by improving menstruation, reducing body fat, and addressing hyperandrogenism, insulin resistance, and chronic inflammation. It may be recommended to utilize omega-3 fatty acids to treat IR linked to PCOS. Additionally, females with IR may benefit from the ketogenic diet as a non-pharmacological treatment (***Malik, et al.,2023).***

Using Pender's health promotion model, nurses can investigate "the complex biopsychosocial mechanisms that motivate females to engage in activities aimed at improving their health.". ***(Sabooteh, et al., 2021).*** Nurses should support females in maintaining a healthy lifestyle, which includes good eating habits. This can help with IR and PCOS symptoms, and even a modest amount of weight loss can benefit psychological, endocrine, and reproductive health. ***(Arasu, et al., 2019).***

Significant of the study:

40% to 50% of obese females with PCOS and 80% of these females worldwide have IR and hyper-insulinemia **(Barber and Franks, 2021).** Furthermore, the most prevalent endocrine condition affecting females between the ages of 18 and 44 is polycystic ovarian syndrome. About 6–18% of teenage females and 2%–20% of females of reproductive age are affected. It affects 1 in 15 females worldwide and is one of the most common endocrine disorders. 38% to 88% of females with PCOS are overweight or obese, according to epidemiological data demonstrating the strong correlation between obesity and PCOS. The degree of IR in females with PCOS is made worse by increasingly subsequent weight gain ***(Barber and Franks, 2021).***

Additionally, 6 million American females suffer from PCOS, compared to 5.6% of Chinese females of reproductive age **(Hajivandi et al., 2020).** In Egypt, the prevalence of IR linked to PCOS varies between approximately 16.5% and 37.5% across reproductive age cohorts and 6.6% among Egyptians ***(Ali, et al.,2023).***

Furthermore, the worldwide recommendations for PCOS and IR recommend nutritional behavior control based on Pender's health promotion model as the first line of treatment (Mansouri et al., 2020). Pender's health promotion program is an effective and economical way to prevent long-term PCOS medication therapy and invasive procedures or surgery **(Guo et al., 2022)**. Furthermore, it was observed that no study has looked at how Pender's health promotion model affected the dietary choices made by females at Benha University Hospitals with polycystic ovaries linked to insulin resistance. Consequently, this study may offer guidance for additional research on this particular subject.

Aim:

The study aimed to examine the effect of Pender's health promotion model on improving the nutritional behavior among women with polycystic ovaries associated insulin resistance.

Hypothesis:

After application of Pender's health promotion model, the studied women will have greater knowledge, acceptable approach of behavior change and health outcomes resulting in favorable nutritional behavior and dietary pattern and significant decrease in body mass index than before.

Operational definitions:

Pender's health promotion model: Pender is a role model for the nursing profession. According to Pender's thesis, positive role models and family support can increase people's willingness to participate in health-promoting activities, which will improve their overall well-being. These factors include behavioral emotions, self-efficacy, perceived barriers, perceived benefits,

interpersonal influencers, situational influencers, and commitment to action.

Nutritional behavior: the sum of all deliberate, spontaneous, or routine acts taken by people or social cohorts to acquire, prepare, and eat food, as well as those pertaining to clearing and storing it.

Conceptual definition:

Insulin resistance: clinical state where insulin's biological impact is less than anticipated. Significant abnormalities in insulin-stimulated glucose uptake, specifically in glycogen synthesis and, to a lesser extent, glucose oxidation, are the cause of this condition.

Subjects and method

Research Design:

One group, time series (pre-post and follow-up), quasi-experimental research approach was employed to attain the aim of this study. A sort of quasi-experiment known as a one-cohort time series design involves measuring the desired outcome both before and after a non-random set of participants is exposed to a particular intervention or treatment **(Cambell and Slanley, 1966).** The directionality of the research, which involves evaluating a dependent variable both before and after intervention with an independent variable, is one benefit of this strategy ***(Cambridge University Press, 2019)***

Study Setting:

This study was carried out in the Obstetrics & Gynecological Outpatient Clinic in the Qaliobya Governorate of Egypt, which is connected to Benha University Hospitals. This clinic offers all females from various socioeconomic backgrounds and geographical locations (rural and urban) free and affordable obstetrics, gynecologic, family planning, and counseling treatments.

Sampling:

Sample type, size and criteria: A purposive sample among those attending the above-mentioned setting according to following ***inclusion criteria:***

- Women medically diagnosed with insulin resistance linked to polycystic ovary.
- Eligible females between the ages of 18 and 40 who are not pregnant or breast feeding.
- Who do not have any underlying medical conditions that could affect their ability to follow their diet
- During the past month, there have been no unpleasant or severe incidents that have caused mental or physical issues.
- Using drugs that impact obesity, such as oral contraceptive pills, has not occurred

Exclusion criteria:

– Having any additional long-term medical conditions or mental health issues;

– Leaving the study for any reason, including moving or missing more than one session.

The sample size was calculated based on the previous annual census report of the outpatient clinic affiliated with the obstetrics and gynecology department at Benha University Hospital ***(Benha University Hospital Statistical Center, 2023),*** where the total number, of females with PCOS-related problems who admitted to the previous setting (65) in the year of 2023. The sample size was calculated utilizing the following formula: **n = N/ 1+N(e)2**

Where :

n= sample size (55).

N= total population number (65).

e= margin error (0.05).

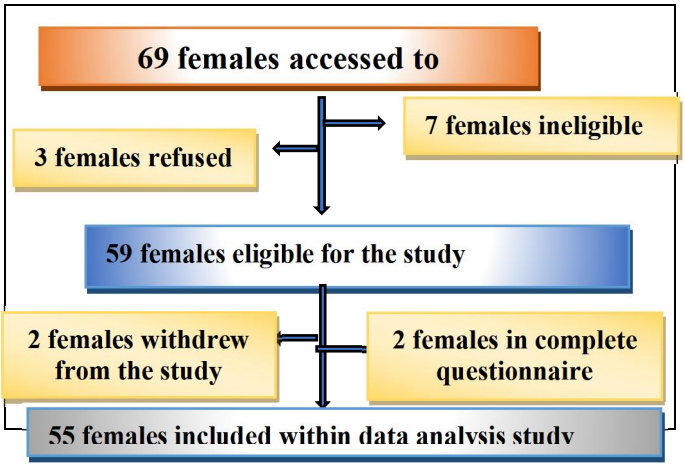


Figure (1): Flow diagram of females enrollment in the study.

Tools of data collection:

Data was gathered using four tools. The research participants' mother tongue, Arabic, was used to translate all of the instruments

Tool I: A structured interviewing questionnaire: It was designed by researchers after reviewing a related literature. It included three parts:

Part (1): Personal characteristics of studied females: It included seven questions: age, education, marital status, place of residence, occupation, monthly income, and time since PCO-related IR was diagnosed.

Part (2): Clinical parameters of PCOS associated IR of studied females: Nine questions about the following conditions were included: hirsutism, oily skin or acne, acanthosis nigricans, thinning hair or hair loss from the head, waistline above 35 inches, skin tags, irregular periods, missed periods, and infertility.

Part (3): Anthropometric measurements of studied females: It included four items: waist circumference, weight, height, and BMI. The following formula was used to determine the BMI:

BMI=body mass (kg)/ height (m^2)

- If BMI is ***less than 18.5***, it falls within the **underweight** range.
- If BMI is ***18.5 to <25***, it falls within the **healthy weight** range.
- If BMI is ***25.0 to <30***, it falls within the **overweight** range.
- If BMI is ***30.0 or higher***, it falls within the **obesity** range.

Tool II: Females' knowledge questionnaire: Following a review of related literature, researchers created it (**de Medeiros et al., 2021; AL Kurdi et al., 2021; de Hyder et al., 2021; Ciarambino et al., 2023**). Its purpose was to gauge females' awareness of IR and polycystic ovaries. This test was divided into two main portions, each of which had 17 multiple-choice questions. There are four possible answers to each question: one correct response, two incorrect responses, and one unknown response. These two segments were:

Section (1): Knowledge about polycystic ovaries: Definition, symptoms, causes, risk factors, consequences, diagnosis, therapy, and healthy practices to prevent warning signs of polycystic ovaries are among the "8 questions" that are included

Section (2): Knowledge regarding insulin resistance: definition, symptoms, causes, risk factors, complications, diagnosis, prevention, dietary behavior to overcome, and treatment are among the "9 questions" that are included.

Scoring algorithm:

Every knowledge question was given a weight based on the elements it contained. Every question received a score of 1 for a right response and a score of 0 for a wrong response or no answer. The sum of the scores for each question was used to determine the final score. The mean of the answers to each question was used to determine the overall mean score of knowledge. Better knowledge is indicated by a higher score, which can range from 0 to 17. Additionally, the overall knowledge score was categorized as follows:

- Good: ≥75% - 100% of total score (13 – 17 score)
- Fair: 50%-<75% of total score (9 –12 score)
- Poor: <50% of total score (0 – 8score)

Tool III: Pender's HPM: It was created by **Dr. Nola Pender et al. (2011)** to assess and clarify the interactions that take place between the females and their surroundings when they are changing their behavior. The HPM aims to prevent and reduce illness risk while also assisting females in changing their behavior to better health outcomes. The

74 items are divided into 7 components, which include: commitment to action (12 items), interpersonal influences (12 items), situational influences (5 items), behavior-related affect (11 items), perceived advantages (11 items), perceived barriers (11 items), and perceived self-efficacy (12 items).

Scoring algorithm:

A five-point Likert-type scale, with 1 denoting strongly disagree and 5 denoting strongly agree, was used to assess each component's items. The scoring for the perceived barriers component was reversed due to its negatively worded answers. Higher HPM scores indicate better health promotion and outcomes; the maximum score is 296 and the minimum is 74. ***The overall score was divided into two levels:***

- Acceptable approach: total scores (> 60 %) = (208 – 296 score).
- Non-acceptable approach: total score (60 % - < 75%) = (74 – 207 score).

Tool IV: Nutritional behavior and dietary pattern questionnaires: It was employed to evaluate the females' dietary patterns, self-regulation of eating behavior, and eating or nutritional behavior. The three components of this tool were as follows:

Part (1): Adult Eating Behavior Questionnaire (AEBQ): The source of the adaptation was **Hunot et al. (2016).** In addition to its impact on health outcomes including weight increase and adult cardiometabolic risk, it is the most used questionnaire for evaluating eating and feeding habits. It included 31 objects with the following two primary dimensions: **Dimension (1):** ***4 'food approach' traits:*** {Hunger (H), Food Responsiveness (FR), Emotional Over-Eating (EOE) and Enjoyment of Food (EF)}. **Dimension (2):** ***4 'food avoidance' traits:*** {Satiety Responsiveness (SR), Emotional Under-Eating(EUE), Food Fussiness (FF) and Slowness in Eating (SR)}.

Scoring algorithm:

Every item received a score on a five-point Likert scale. The AEBQ's response possibilities for "food avoidance" qualities varied from disagree = 0 to strongly agree = 4, whereas "food approach" traits had the opposite scoring scheme. Higher scores on the AEBQ indicate better feeding and eating habits; the maximum score is 140, while the minimum is 0. ***The overall score was divided into three levels:***

- Favorable behavior: ≥75% - 100% of total score (105 – 140 score).
- Partly favorable: 50%-<75% of total score (70 –104 score).
- Unfavorable: <50% of total score (0 –69 score).

Part (2): Self-Regulation of Eating Behaviour Questionnaire (SREBQ): The source of the adaptation was Kliemann et al. (2016). There are five items. The primary self-regulation processes (self-monitoring, evaluating progress, making adjustments, giving up, and overcoming obstacles) were covered by SREBQ. The following sentences and their definitions were also included in the items:

- ***I'm good at resisting tempting food:*** Short-term ability to control eating behaviors and the ability to control behavior, emotions, feelings, and attention when eating in accordance with your intentions.
- ***I give up too easily on my eating intentions:*** The ability to maintain your eating goals and consistently strive toward them, as well as the long-term capacity to control your eating habits.
- ***I easily get distracted from my eating intentions:*** The capacity to regulate your thoughts and focus while maintaining your eating objectives.
- ***I find it hard to remember what I have eaten throughout the day:*** The capacity to track and recognize your true eating habits.

- ***If I am not eating in the way, I intend to I make changes:*** The ability to make changes as needed to reach your goals by comparing your actual behavior to your reference eating intents.

Scoring algorithm:

Every item has a score between 0 and 6. With a minimum score of 0 and a maximum score of 30, the SREBQ measures a person's capacity to control their eating habits. The sum of the points for each item was used to determine the final score. By computing the mean of replies for each item, the SREBQ's overall mean score was determined.

Part (3): Diet pattern questionnaire: This section was taken from ***AL Kurdi et al. (2021)*** and used nine questions to evaluate the females' eating habits: how many meals they eat each day, where they eat them, whether they eat meals from outside the house, what kind of food they eat frequently, whether they eat fast food, how often they eat sweets, chocolate, and cake, how often they eat fruits and vegetables, how often they eat meat, and how many cups of water they drink each day

Tools validity:

Two jury experts from Benha University's obstetrics and gynecological nursing and one from Community Health nursing program assessed the validity of the questionnaires to make sure they were clear, pertinent, thorough, and applicable. Small changes were made, such as forming, adding, or removing certain items. The instruments were regarded as legitimate by the experts.

Tools reliability:

The Cronbach's Alpha coefficient test was used to assess the tools' reliability, and the results showed that each tool's internal consistency was as follows:

Tool	Cronbach's alpha value
Tool II: Females's knowledge questionnaire.	(α = 0.91).
Tool III: Pender's Health Promotion Model (HPM).	(α = 0.854).
Tool IV: Nutritional behavior and dietary pattern questionnaires: ▪ Adult Eating Behavior Questionnaire (AEBQ). ▪ Diet pattern. ▪ Self-Regulation of Eating Behaviour Questionnaire SREBQ.	(α = 0.954). (α = 0.826). (α = 0.75).

Ethical consideration:

Before the study begins, the following ethical considerations will be made: The scientific research ethics committee of Benha University's nursing department granted study approval for the study's completion. The chosen research sites formally granted permission for the study to be conducted (Code : REC-OBSN-P38) .The researchers gained females' trust and confidence by explaining the purpose and significance of the study before using the instruments. Females gave the researchers their formal agreement to take part in the study, and confidentiality was guaranteed. There were no dangers to the females' physical, social, or mental health during the trial. To protect the privacy of the participating females, all data collection instruments were destroyed following statistical analysis. The study materials respected human rights and contained no unethical claims. The females could leave the research at any moment.

Pilot study:

Five females, or 10% of the total sample size, participated in the pilot study to test the tools' objectivity, clarity, feasibility, and applicability. It also aimed to identify any issues that might arise for the researcher and impede data collection, as well as any issues specific to the statements, such as the questions' sequence or clarity. Estimating

the amount of time required for data gathering was also beneficial. In order to prevent sample contamination, the pilot sample was removed from the study and adjustments were made based on the pilot results.

Field work:

The study was conducted for eight months, starting in early March 2024 and ending at the end of October 2024. Until the predefined sample size was reached, the researchers conducted the study twice a week (on Saturdays and Mondays) from 9:00 a.m. to 12:00 p.m. at the previously specified location. Before or after an obstetrician appointment, the researchers conducted small-cohort interviews with the females; on average, 1-2 females were questioned per week. In order to spread the advantage, the handout (booklet) from this study was placed in the obstetric and gynecological outpatient clinic and given to all females who had IR linked to polycystic ovaries.

The following five stages were used to carry out the current study: planning, implementation, evaluation, interviewing and assessment, and preparation. To protect participant privacy and confidentiality, these phases were conducted in a private room at the prenatal clinic.

Preparatory phase:

The first stage of the research process is called the preparatory phase, during which the researchers examined relevant local and worldwide literature regarding the research subject. This aided the researchers in understanding the scope and gravity of the issue and directed them in preparing the necessary instruments for gathering data. Three obstetrics and gynecological nursing specialists from Benha University's faculty were given the instruments, and the jury outcomes were completed. 0626

Interviewing and assessment phase:

At the beginning of the interview the researchers welcomed the woman, introduced They introduced themselves to each of the females involved in the study, explained its goal, gave them all the details on the number and frequency of sessions, scheduled visits, and other information to ensure their adherence to the interventions, and obtained their signed agreement to take part. Using a weight scale and measuring tape, the females were initially questioned to determine their personal characteristics, clinical markers of IR linked to PCOS, and anthropometric measurements (height, weight, BMI, and waist circumference) ***(Tool: I)***. The researchers next evaluated females' understanding of IR and PCOS using ***(Tool: II).*** The interactions between the females and their surroundings during the behavior modification process were then evaluated using Pender's Health Promotion Model ***(Tool: III).*** Lastly, the self-regulation of eating behavior, diet pattern, and eating or nutritional behavior of females were evaluated using ***(Tool: IV).***

Planning phase:

The researchers created instructional sessions regarding PCOS-associated IR in the form of a printed booklet with colored illustrations based on the findings from the evaluation phase. The booklet was created especially in plain Arabic to accommodate the researched females' little knowledge and to match their comprehension level. The number of sessions, their contents, various teaching modalities, and educational media are decided. After completing Pender's Health Promotion Model, goals were created to be achieved. The overall goal was for each woman to leave the educational sessions with a basic understanding of IR linked to PCOS and be able to successfully

modify their dietary habits, nutritional practices, and health promotion behaviors in order to reduce their BMI and address the negative effects of PCOS-related insulin resistance.

Educational material (booklet):

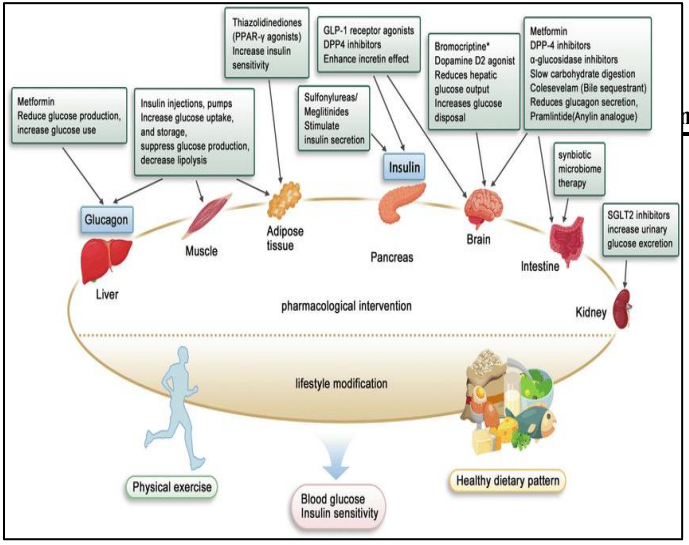
It was created and updated to provide ladies with thorough instructions and information. The brochure was divided into four sections. The first section included a basic overview of PCOS. IR was the subject of the second section. Pender's Health Promotion Model—which includes behavior-related affect, perceived barriers, perceived advantages, perceived self-efficacy, interpersonal influences, situational effects, and commitment to action—was the basis for the third section's discussion of health promotion techniques. The fourth section included proper nutrition, techniques for controlling one's eating habits, a balanced diet, and issues brought on by consuming bad foods.

Implementation phase

Using four distinct scheduled sessions over the course of two weeks, the researcher created and carried out the educational intervention based on Pender's model structures. Eleven cohorts of five ladies each were formed from the recruited females. Following the conclusion of the assessment phase, each appointment was held in a private room in the outpatient clinic at Benha University hospitals. Based on their input and accomplishments, each session lasted roughly 40–50 minutes, with a 10-minute break. Females were briefed on the contents of the intervention at the start of the first session. The next session began with a review of the previous one and the goals of the new one. To accommodate females' comprehension levels, basic Arabic was employed. A few minutes were set out at the conclusion of each session to allow ladies to ask questions in order to clear up any confusion and clarify the session's contents. Every woman was notified of the next session's time.

Lectures, cohort discussions, downloaded films, critical thinking, problem solving, and brainstorming were among the several educational techniques that were employed. In order to accomplish the study's goals, instructional material include useful tools like laptops and PowerPoint presentations. Additionally, a booklet was given to all females who were recruited for the study starting with the first session. Additionally, the researchers employed stickers and flyers that highlight the concepts and the impact of the intervention as supportive aids that serve as stimulus control to support desirable changes.

- **The first session** PCOS was covered in the first session, along with its definition, symptoms, causes, risk factors, complications, diagnosis, therapy, and healthy practices to lower its warning signals.
- **The second session** covered the definition, symptoms, causes, risk factors, complications, prevention, diagnosis, dietary behavior to overcome, and therapy of insulin resistance.
- **The third session** covered health promotion techniques based on Pender's Health Promotion Model (perceived advantages of eating a healthy diet, perceived obstacles to eating a healthy diet and the solutions offered to overcome them), perceived self-efficacy (in the self-efficacy domain, strategies such as verbal persuasion, encouragement and reinforcement of healthy behavior, offering the experiences of successful vicarious learning, particularly among peers, and encouragement to mastery experience of the behavior), behavior-related affect, interpersonal influences, situational influences, and commitment to



action to the presented healthy nutritional behaviors).

- **The fourth session** Proper nutrition, eating-habit management strategies, a healthy diet, problems caused by eating bad foods, the importance of weight loss, and following treatment instructions were the subjects of the fourth session.
  - Whole grains, legumes, nuts, seeds, fruits, starchy vegetables, and other unprocessed, low-carbohydrate foods were all part of the low glycemic index diet.
  - An anti-inflammatory diet that consists of foods like leafy greens, fatty fish, chicken, berries, and extra virgin olive oil may help lessen symptoms of inflammation like exhaustion.
  - Dietary Strategies: to help reduce the symptoms of IR and PCOS. Fast food should be limited, meals high in sugar and saturated fat should be avoided, and low-fat dairy products are advised.
  - Females were taught the value of losing weight while undergoing treatment and how to improve their quality of life by engaging in physical activity, doing daily exercises, and taking walks of at least thirty minutes each day.
  - Females were instructed about their ***commitment to treatment protocol*** and attendance for the follow-up-evaluation phase, besides the action of medication was explained to females.

Figure (2): Therapeutic strategy of insulin resistance

Lastly, the researchers followed up with the females during the time between the implementation and evaluation phases by holding frequent meetings, calling, or messaging them on social media platforms like WhatsApp to ensure that they complied with the guidelines regarding dietary patterns and nutritional behavior. They also provided educational sessions to address the females' inquiries and improve implementation.

Evaluation phase:

Using the same format of tools (Tool II, Tool III, and Tool IV) used during the assessment phase, the effectiveness of Pender's Health Promotion Model in improving nutritional behavior among females with IR associated with polycystic ovaries was assessed twice: once a month after the intervention and three months after the last session following implementation. Follow-up visits were conducted to monitor and assess the females under study. Females are guaranteed to visit and return to the hospital during the prearranged evaluation periods so that their waist circumference, height, weight, and BMI can be reassessed.

Statistical analysis:

Data were checked before being entered into the computer. Using the proper statistical techniques and procedures, the gathered data will be arranged, coded, processed, and examined. Version 22.0 of the Statistical Package for Social Sciences (SPSS) was employed. Means, standard deviations, and frequencies and percentages were examples of descriptive statistics. The study hypotheses were tested using inferential statistics such as the Friedman and ANOVA tests. The relationship between the research variables' total scores was examined using the correlation coefficient. P-value > 0.05 denoted no statistically significant difference, p-value <0.05 denoted a statistically significant difference, and p-value $P \leq 0.001$ denoted a highly

statistically significant difference for all statistical tests performed.

Limitations:

There were a few restrictions, such as the outpatient clinic's waiting area occasionally being packed and noisy. In order to assist the females, feel free during educational sessions, the researchers may have to wait a long time until the room is calm and empty. Additionally, some females did not attend the educational sessions on a regular basis, thus it was necessary to call and remind them of their appointments. Additionally, there were issues with scheduling and coordinating phone calls. Lastly, the generalizability of study results is limited by non-probability purposive sampling; this is in addition to the absence of national and international references that looked at the variables that were chosen.

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Results

Table (1): Distribution of the studied females according to their personal characteristics (n.=55).

Personal characteristics	No.	%
Age (in years):		
18 - <25	24	43.6
25 - <30	11	20.0
30 - <35	10	18.2
35 – 40	10	18.2
Mean ± SD = 28.11±5.99		
Educational level:		
Read and write	2	3.6
Basic education	10	18.2
Secondary education	16	29.1
University education	27	49.1
Marital status:		
Single	19	34.5
Married	36	65.5
Residence:		
Rural	20	36.4
Urban	35	63.6
Occupation:		
Working	39	70.9
Not working	16	29.1
Monthly income:		
Enough	11	20.0
Not enough	44	80.0
Duration since diagnosis of PCO associated insulin resistance:		
1-2 years	20	36.4
3-4 years	24	43.6
≥ 5 years	11	20.0
Mean ± SD = 3.29±1.54		

Table (1): reveals that the majority of the females in the study (43.6%) were between the ages of 18 and 25. Their mean age was 28.11±5.99 years. In terms of education, two-thirds of them (65.5%) were married, and less than half of them (49.1%) had a university degree. In terms of residency, fewer than two-thirds (63.6%) of them were urban dwellers. They were also less than three-quarters (70.9%) employed. The vast majority of them (80.0%) did not have enough money each month. Furthermore, with a mean of 3.29±1.54 years, less than two-fifths of them (43.6%) were diagnosed with PCO-associated IR3–4 years ago.

Table (2): Distribution of the studied females according to clinical parameters of PCOS associated IR (n.=55) *.

Clinical parameters	No.	%
Irregular periods	46	83.6
Missed periods	9	16.4
Hirsutism	15	27.3
Oily skin or acne	22	40.0
Acanthosis nigricans (Patches of dark, velvety skin)	7	12.7
Thinning hair or hair loss from the head	31	56.4
Waistline over 35 inches.	21	38.2
Skin tags (extra skin. in armpits or on neck).	6	10.9
Infertility	27	49.1

Table (2): showed that most of the females in the study (83.6%) experienced irregular periods, and over half of them (56.4%) complained of head hair loss or thinning hair. Furthermore, infertility affected 49.1% of them, which is less than half. Additionally, two-fifths of them (40.0%) said that they were uncomfortable with acne or greasy skin. More than one-third of them (38.2%) had waist circumferences greater than 35 inches. Additionally, hirsutism affected more than a quarter of them (27.3%). Lastly, a small percentage of them expressed frustration with symptoms like skin tags, acanthosis nigricans, and missed periods.

Table (3): Mean scores of studied females' BMI at pre-intervention, post-intervention and follow up phases (n.=55).

Program phases	Pre-intervention	Post-intervention	Follow up	ANOVA	
	Mean ± SD	Mean ± SD	Mean ± SD	F	p-value
BMI	28.38±2.72	26.91±1.60	25.24±1.43	33.85	0.000**

Table (3): The study's females' BMI, represented by their mean BMI, was 28.38±2.72 kg/m2, 26.91±1.60 kg/m2, and 25.24±1.43 kg/m2 at the pre-intervention, post-intervention, and follow-up phases, respectively. The differences between program phases were highly statistically significant ($p \leq 0.001$).

Figure (1): Percentage distribution of studied females regarding their BMI at pre-intervention, post-intervention and follow up phases (n=55).

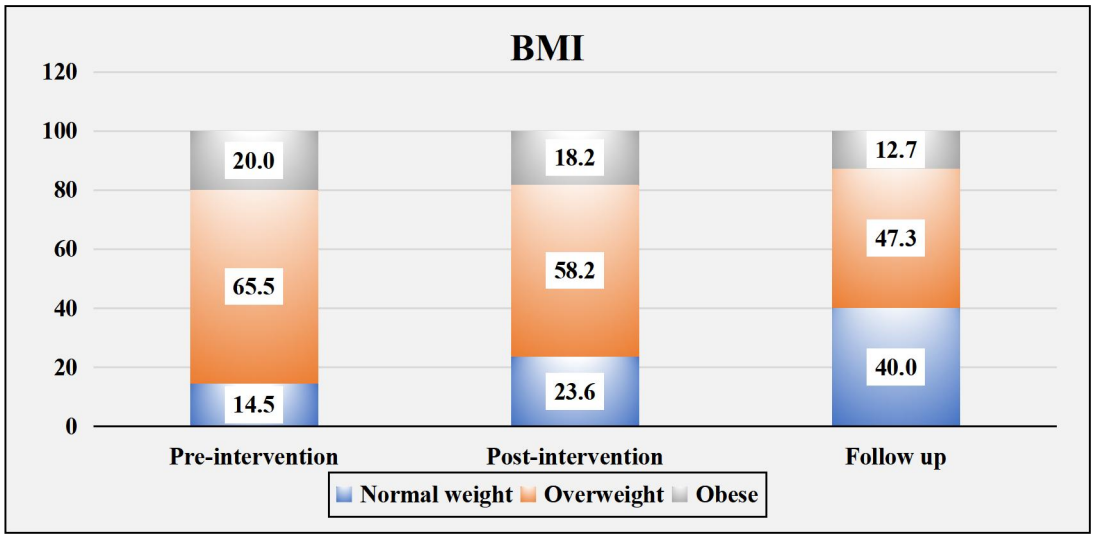

Fig. (1): explains that a significant decrease in BMI was observed across program phases, with 14.5%, 23.6%, and 40.0% of the females under study having normal weight during pre-intervention, post-intervention, and follow-up phases, respectively.

Table (4): Mean Scores of studied females' knowledge regarding PCOS and IR at pre-intervention, post-intervention and follow up phases (n=55).

Dimensions	Min./Max. score	Pre-intervention	Post-intervention	Follow up	ANOVA	
		Mean ± SD	Mean ± SD	Mean ± SD	F	P-value
Knowledge regarding PCOS	0/8	4.42±1.54	5.60±1.38	6.51±1.34	29.64	0.000**
Knowledge regarding IR	0/9	3.29±2.11	4.73±1.68	6.71±1.48	51.01	0.000**
Total score	**0/17**	**7.70±2.79**	**10.32±2.34**	**13.21±2.01**	**72.06**	**0.000****

Table (4): explains that the mean scores of the females' knowledge on PCOS and IR at the pre-, post-, and follow-up phases were highly statistically significant (p-value<0.001). Over the course of the trial, the average knowledge score increased from 7.70±2.79 to 10.32±2.34 to 13.21±2.01; the follow-up phase was the most favorable.

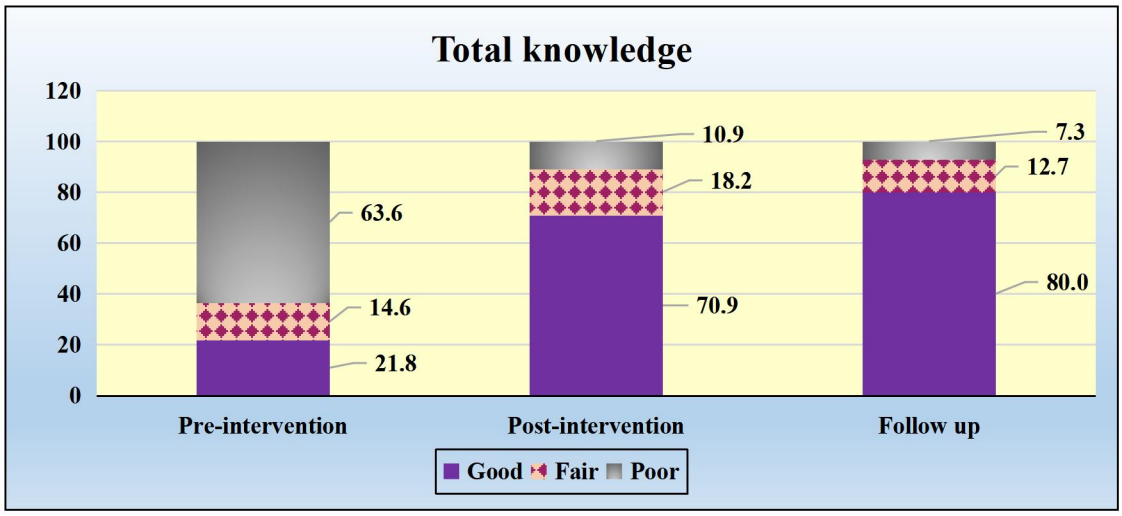

Figure (2): Distribution of studied females regarding total knowledge score at pre-intervention, post-intervention and follow up phases (n=55).

Figure (2): demonstrates that at the pre-intervention, post-intervention, and follow-up phases, respectively, 21.8%, 70.9%, and 80.0% of the females in the study possessed good knowledge on PCOS and insulin resistance.

Table (5): Mean Scores of Pender's Health Promotion Model components of studied females in terms of nutritional behaviors at pre-intervention, post-intervention and follow up phases (n=55). 1 2 3 4

Components	Min./Max. score	Pre-intervention	Post-intervention	Follow up	ANOVA	
		Mean ± SD	Mean ± SD	Mean ± SD	F	P-value
Perceived benefits	11/44	28.73±6.95	32.82±6.05	35.18±5.59	15.13	0.000**
Perceived barriers	11/44	20.18±5.38	26.45±4.91	32.73±4.49	88.47	0.000**
Perceived self-efficacy	12/48	27.18±7.05	31.55±+6.27	36.64±7.93	24.28	0.000**
Behavior-related affect	11/44	25.82±4.92	31.91±4.00	35.91±4.48	70.63	0.000**
Interpersonal influences	12/48	33.8±7.14	37.91±6.81	41.09±5.92	16.45	0.000**
Situational influences	5/20	14.45±3.53	16.82±2.74	18.64±1.78	31.22	0.000**
Commitment to action	12/48	20.63±5.20	28.09±3.90	34.36±3.92	134.86	0.000**
Total score	**74/296**	**170.81±17.73**	**205.54±14.12**	**234.54±13.86**	**237.85**	**0.000****

Table (5): demonstrates a substantial statistical difference between the mean scores of the females under study for the nutritional habits components of Pender's health promotion model at the pre-, post-, and follow-up phases (p-value<0.001). Throughout the study phases, the females' overall mean score on Pender's health promotion model improved from 170.81±17.73 to 205.54±14.12 to 234.54±13.86, favoring the follow-up period.

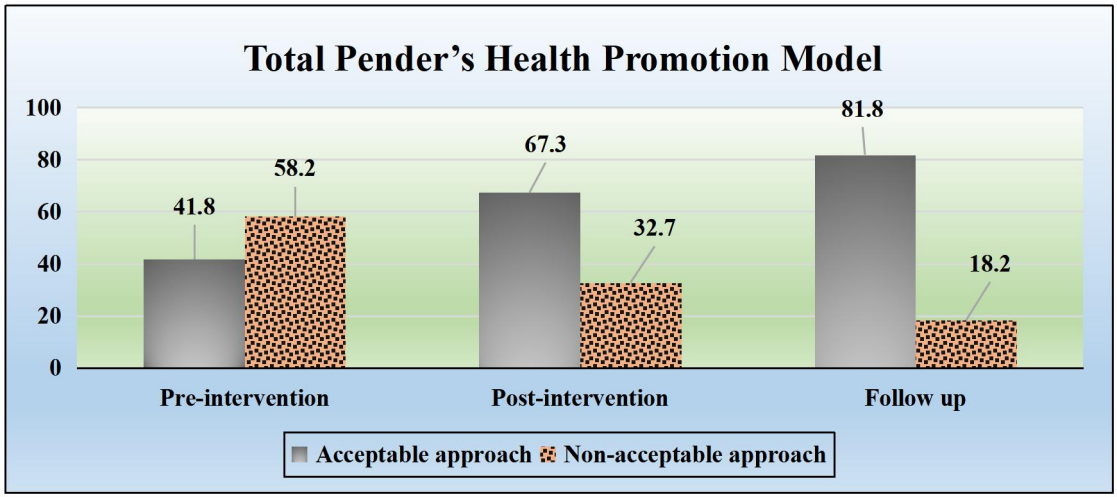

Figure (3): Distribution of studied females regarding total Pender's Health Promotion Model score at pre-intervention, post-intervention and follow up phases (n=55).

Figure (3): shows that at the pre-intervention, post-intervention, and follow-up phases, respectively, 41.8%, 67.3%, and 81.8% of the females in the study had an acceptable attitude to Pender's health promotion model.

Table (6): Mean Scores of studied females' eating or nutritional behavior at pre-intervention, post-intervention and follow up phases (n=55).

Appetitive traits Dimensions	Min./Max. score	Pre-intervention	Post-intervention	Follow up	ANOVA	
		Mean ± SD	Mean ± SD	Mean ± SD	F	p-value
Food approach' traits						
Hunger (H)	0/20	5.00±1.87	9.09±2.63	13.73±2.69	177.79	0.000**
Food Responsiveness (FR)	0/16	3.18±1.65	7.36±1.73	12.09±1.79	364.65	0.000**
Emotional Over-Eating (EOE)	0/20	5.45±3.99	9.82±4.46	13.45±3.58	54.24	0.000**
Enjoyment of Food (EF)	0/12	1.18±1.27	4.36±1.37	7.55±1.84	240.83	0.000**
Food avoidance' traits						
Satiety Responsiveness (SR)	0/16	2.27±1.61	4.81±1.65	6.90±1.69	108.27	0.000**
Emotional Under-Eating(EUE)	0/20	1.45±1.38	3.45±1.38	5.55±1.31	123.90	0.000**
Food Fussiness (FF)	0/20	1.81±0.94	3.90±1.00	7.09±1.45	289.09	0.000**
Slowness in Eating (SR)	0/16	5.64±1.37	8.64±2.03	11.55±2.25	129.83	0.000**
Total score	**0/140**	**26.00±5.70**	**51.45±7.24**	**77.90±8.89**	**676.89**	**0.000****

Table (6): demonstrates that the mean scores of the females under study in relation to eating or nutritional behavior (food approach and food avoidance traits) varied significantly (p-value<0.001) before, during, and after the intervention. Throughout the study phases, the overall mean score of the females' eating or nutritional behavior grew from 26.00±5.70 to 51.45±7.24 and 77.90±8.89, favoring the follow-up phase.

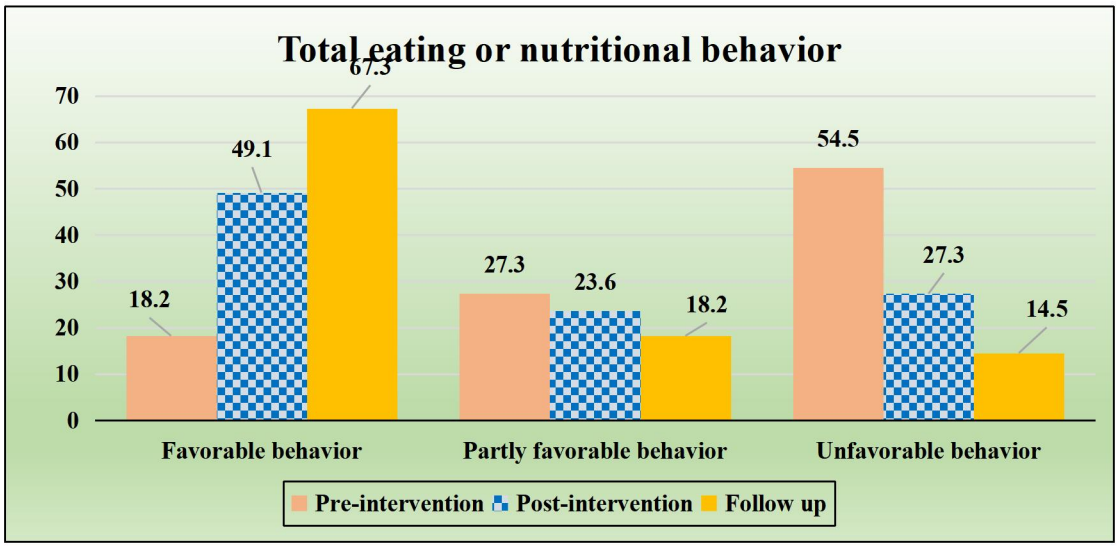

Figure (4): Distribution of studied females regarding total eating or nutritional behavior score at pre-intervention, post-intervention and follow up phases (n=55).

Figure (4): shows that the investigated females' beneficial eating or nutritional behavior was present during the pre-intervention, post-intervention, and follow-up phases in 18.2%, 49.1%, and 67.3% of cases, respectively.

Table (7): Mean Scores of studied females' self-regulation of eating behavior at pre-intervention, post-intervention and follow up phases (n=55).

Dimensions	Min./Max. score	Pre-intervention	Post-intervention	Follow up	ANOVA	
		Mean ± SD	Mean ± SD	Mean ± SD	F	p-value
I'm good at resisting tempting food.	0/6	1.55±1.31	3.73±1.22	4.18±1.12	72.91	0.000**
I give up too easily on my eating intentions.		0.82±1.03	2.27±0.75	3.27±0.75	113.11	0.000**
I easily get distracted from my eating intentions.		2.18±1.03	3.18±1.12	4.36±0.98	59.34	0.000**
I find it hard to remember what I have eaten throughout the day		3.09±1.57	4.18±1.41	5.00±1.21	25.32	0.000**
If I am not eating in the way I intend to I make changes		3.00±1.13	3.96±1.10	4.73±0.87	37.74	0.000**
Total score	**0/30**	**10.63±3.17**	**17.32±2.71**	**21.54±1.89**	**237.67**	**0.000****

Table (7): demonstrates that the mean scores of the females under study in relation to self-regulation of eating behavior at the pre-, post-, and follow-up phases differed significantly (p-value<0.001). Over the course of the trial, the average score for the females' self-regulation of eating behavior rose from 10.63±3.17 to 17.32±2.71 to 21.54±1.89, favoring the follow-up period.

Table (8): Distribution of the studied females according to their diet pattern at pre-intervention, post-intervention and follow up phases (n=55).

Items	Pre-intervention		Post-intervention		Follow up		Friedman test	
	No.	%	No.	%	No.	%	X^2	P-value
Number of meals daily								
One meal/day	3	5.5	2	3.7	0	0.0	**18.50**	**0.000****
Two meals/day	28	50.9	16	29.1	11	20.0		
Three meals/day	10	18.2	24	43.6	35	63.6		
Four meals or more/day	14	25.4	13	23.6	9	16.4		
Place of daily meals								
Inside the house	27	49.1	33	60.0	40	72.7	**19.53**	**0.000****
Outside the house	28	50.9	22	40.0	15	27.3		
Eating meals from outside the home/week								
Rarely	6	10.9	19	34.5	23	41.8	**84.69**	**0.000****
Once a week	12	21.8	21	38.2	20	36.4		
Twice a week	20	36.4	10	18.2	8	14.5		
3 or more	17	30.9	5	9.1	4	7.3		
Type of highly used food/day								
Meat or Fish	9	16.4	13	23.6	15	32.7	**25.61**	**0.000****
Vegetables and fruits	6	10.9	14	25.5	18	14.5		
Carbohydrate	24	43.6	11	20.0	8	9.1		
Sugar food	10	18.2	7	12.7	5	16.4		
Legumes	6	10.9	10	18.2	9	32.7		
Eating fast food/week								
Rarely	5	9.1	8	9.1	16	29.1	**53.65**	**0.000****
Once a week	12	21.8	17	21.8	21	38.2		
Twice a week	28	50.9	22	50.9	12	21.8		
3 or more	10	18.2	8	18.2	6	10.9		
Eating sweets, chocolate, cake								
Once a week	7	12.7	25	45.5	38	69.1	**64.75**	**0.000****
Twice a week	17	30.9	11	20.0	8	14.5		
3 or more	31	56.4	19	34.5	9	16.4		
Frequency eating fruits and vegetables /day								
Rarely	32	58.2	19	34.5	4	7.3	**56.14**	**0.000****
Once	9	16.4	18	32.7	21	38.1		
Twice	9	16.4	14	25.5	26	47.3		
Three more times	5	9.0	4	7.3	4	7.3		
Frequency eating meat/day								
Rarely	39	70.9	22	40.0	12	21.8	**53.11**	**0.000****
Once	11	20.0	22	40.0	31	56.4		
Twice	5	9.1	11	20.0	12	21.8		
Amount of water consumed daily in cups								
2 Cups	25	45.5	10	18.2	4	7.3	**74.04**	**0.000****
3-4 Cups	13	23.6	20	36.4	10	18.2		
5-6 Cups	10	18.2	12	21.8	19	34.5		
7-8 Cups	7	12.7	13	23.6	23	41.8		

Table (8): explains that, when comparing the pre-intervention, post-intervention, and follow-up periods, there was a highly significant variation in all items pertaining to the eating pattern of the females under study (P≤0.001).

Table (9): Correlation between total score of nutritional behavior and BMI of the studied females at pre-intervention, post-intervention and follow up phases (n=55).

Variables	Total nutritional behavior					
	Pre-intervention		Post-intervention		Follow up	
	r	P-value	r	P-value	R	P-value
BMI	- 0.362	0.000**	- 0.423	0.000**	- 0.447	0.000**

Table (9): clarifies that there was a highly significant statistical negative correlation between total score of nutritional behavior of the studied women and their total score of BMI at pre-intervention, post-intervention and follow up phase (P≤0.001).

Discussion

Females with PCOS-related IR are more likely to be overweight or obese, and these conditions are strongly associated with a number of symptoms and long-term health issues that these females face. According to research, the first line of treatment frequently entails changing one's lifestyle, including eating habits, physical activity levels, and nutritional behavior, in order to promote weight loss using Pender's health promotion model (***Moran, et al.,2023)***

The goal of the current study was to determine whether Pender's health promotion model could improve the dietary habits of females with IR linked to polycystic ovaries. Personal characteristics of the females under study, clinical parameters of IR associated with PCOS, anthropometric measurements, knowledge of polycystic ovaries and insulin resistance, Pender's health promotion model components, nutritional behavior and dietary pattern, and the relationship between the study females' BMI and their overall nutritional behavior score are all covered in this study. Furthermore, a high statistically significant improvement in the scores for all study variables during the pre-, post-, and follow-up phases (p-value<0.001) supported the acceptance of the research hypothesis.

The study's findings regarding personal characteristics revealed that, with a mean age of 28.11±5.99 years, almost two-fifths of the females were between the ages of 18 and 25. In terms of education, fewer than two-thirds of them were married, and less than half had a university degree. In terms of residence, fewer than two-thirds of them were urban dwellers. And fewer than three-quarters of them were employed. Most of them did not have enough money, given their monthly wage. Furthermore, with a mean of 3.29±1.54 years, less than two-fifths of them were diagnosed with PCO-associated IR3–4 years ago.

These results were consistent with those of Artyomenko et al. (2023), who demonstrated that, with respect to the sociodemographic distribution of the participants, two-fifths of the females in the study were between the ages of 18 and 30 (mean age: 27.11±6.99 years). In terms of education, just over half of them were married, and over half had a university degree. Moreover, over three-quarters of

them were employed. With a mean age of 2.30±3.54 years, over two-fifths of them were diagnosed with a metabolic disease linked to PCO 4-5 years ago. More than one-third of the females in the study were in the 18–25 age range, with a mean age of 28.91 ±7.35 years, according to Saeed et al. (2023). In terms of education, roughly two-fifths of the females in the study had a university degree, the majority were employed, the majority had low incomes, and fewer than three-quarters were married. In contrast, the bulk of the females in the study lived in rural areas. This could be explained by PCOS, a prevalent illness that mostly affects females of reproductive age, according to the results stated above.

According to the clinical criteria of the females in the study concerning IR linked to PCOS, most of the females experienced irregular periods, over half complained of thinning or head hair loss, and less than half experienced infertility. Additionally, two-fifths of them mentioned how uncomfortable they were with acne or greasy skin. It was discovered that nearly one-third of them had waist circumferences greater than 35 inches. Furthermore, over 25% of them experienced hirsutism. Lastly, a small percentage of them expressed discontent with symptoms like skin tags, acanthosis nigricans, and missed periods.

These findings aligned with those of Siam et al. (2020), who reported that, in terms of gynecological presentation, the majority of females in the PCOS cohort experienced irregular periods, with less than half reporting hair loss and two-fifths reporting acne. Two-fifths of them had waist circumferences greater than 37 inches. Furthermore, less than 25% of them experienced hirsutism. Less than one-fifth of them subsequently reported symptoms including irregular periods and amenorrhea. That makes sense given that the results of the previously mentioned study show how all complaints from females may be described using the Rotterdam criteria.

Given that PCOS and obesity appear to be closely related, the mean BMI scores of the females in the study were 28.38±2.72 kg/m2, 26.91±1.60 kg/m2, and 25.24±1.43 kg/m2 at the pre-intervention, post-intervention, and follow-up phases, respectively. The differences between program phases were highly statistically significant ($p \leq 0.001$). Furthermore, a significant decrease in BMI was observed throughout the program phases, with about one-seventh, less than one-quarter, and two-fifths of the females under study having normal weight at pre-intervention, post-intervention, and follow-up phases, respectively. This demonstrated how the females' BMI was positively impacted by Pender's health promotion approach, which validates the current study's research premise.

The current study's results were nearly identical to those of Araby et al. (2024), who demonstrated that the mean BMI of the females under study was 27.45±4.28 kg/m2, 25.78±3.09 kg/m2, and 26.02±3.07 kg/m2 at the pre-implementation, 4-week, and 3-month post-implementation phases, respectively, with a statistically significant difference between the three adoption phases ($p \leq 0.05$). In the pre-implementation, 4-week, and 3-month post-implementation phases, respectively, three-fifths, less than half, and half of the females in the study experienced overweight; this indicates a significant decrease in BMI over the course of the three implementation phases. Furthermore, Zhou et al. (2020) verified that a significant decrease in BMI was observed throughout program phases, with over one-fifth, less than one-third, and more than two-fifths of the females in the intervention cohort having normal weight at pre-intervention, six months, and twelve months after intervention, respectively. This supported the idea that changing a woman's

lifestyle and modifying her weight using the health promotion model and other lifestyle modification theories is the first line of treatment for IR linked to PCOS.

Recent findings revealed a large statistically significant difference in the mean scores of the females' knowledge on PCOS and IR at the pre-, post-, and follow-up phases (p-value <0.001). In the favor follow-up phase, the overall mean knowledge score increased from 7.70±2.79 to 10.32±2.34 and 13.21±2.01 during the course of the study. Similarly, in the pre-intervention, post-intervention, and follow-up periods, the majority of the females in the study knew a lot about PCOS and insulin resistance, whereas less than three quarters did not. This can be explained by the fact that an educational program founded on Pender's health promotion enhanced the knowledge of the females under study, which was evident in their positive PCOS treatment regimen, acceptable nutritional behavior, and lifestyle change. The aforementioned findings lend credence to the present research concept.

In the same context, Abdelnaem et al. (2023) showed that the study sample's overall knowledge score on PCOS was as follows: less than 10% of the sample had poor knowledge in the posttest, down from less than 75% in the pretest. They showed extremely statistically significant gains in their knowledge level, with a mean score of 13.08±4.871 on the pretest and 24.91±5.415 on the posttest. The latest findings increasingly supported those of Abraham et al. (2022), who reported that the posttest mean score of students' knowledge was significantly higher than the pretest knowledge score, and Valarmathi and Metilda (2022), who found that girls' knowledge of PCOs improved after the video assisted teaching program. In addition to the results of Arora et al. (2021), which shown that educational programs enhanced teens' PCOS knowledge scores. Additionally, research by Mala et al. (2019) and Almukhtar (2019) found that participants' knowledge scores on all PCO-related knowledge categories improved after the educational intervention**.**

The nutritional behaviors at the pre-intervention, post-intervention, and follow-up phases showed a strong statistically significant difference (p-value<0.001) when comparing the mean score of Pender's health promotion model component. Throughout the study phases, the females' overall mean score on Pender's health promotion model improved from 170.81±17.73 to 205.54±14.12 to 234.54±13.86, favoring the follow-up period. Furthermore, at the pre-intervention, post-intervention, and follow-up phases, respectively, over two-fifths, over two-thirds, and the majority of the females in the study had an acceptable approach to Pender's health promotion model. This can be explained by the fact that educational programs for females with IR linked to PCOS can be made more effective by employing Pender's health promotion model as a framework.

The aforementioned findings concurred with those of El-Aal et al. (2022), who demonstrated that, for every component in Pender's health promotion model, the mean score improved statistically significantly after the intervention as opposed to before (p-value = 0.000). Furthermore, the mean total score of PHPM ideas rose to 175 ±33.8 in the post-intervention period from 113 ±41.7 in the pre-intervention period (p-value =0.000), indicating a statistically significant improvement. Post-intervention levels of Pender health promotion model principles among the females under study showed a statistically significant improvement over pre-intervention levels (p=0.000). Compared to more than half of the females in the study before the intervention, the majority of the

females in the study who had good levels of perceived benefits from exercise and a healthy diet had improved after the intervention, while more than two-thirds of the females in the study had improved after the intervention.

In addition, Mohamed et al. (2022) explained that all of the Pender's promotion model drivers of healthy behaviors showed a highly statistically significant difference between the pre- and post-counseling program (P<0.001). Additionally, after the counseling program, rather than before, the mean scores of every item in Pender's model considerably improved. According to Pender's determinants of healthy behaviors, over 25% of the sample under study had good overall behavior levels prior to the counseling program, and the majority did so after the program. Less than three-quarters of the sample exhibited bad overall conduct prior to the counseling program, but less than ten percent did so after the counseling session.

The current study's findings regarding the eating or nutritional behavior of the females under investigation showed a significant statistical difference between the mean scores of eating or nutritional behavior (food approach and food avoidance traits) at the pre-, post-, and follow-up phases (p-value<0.001). Throughout the study phases, the overall mean score for the females' eating or nutritional behavior climbed from 26.00±5.70 to 51.45±7.24 to 77.90±8.89, favoring the follow-up phase. In other words, at the pre-intervention, post-intervention, and follow-up periods, less than five percent, less than half, and more than two-thirds of the females in the study exhibited beneficial eating or nutritional behavior, respectively. As the precise cause of PCOS is unknown, lifestyle modifications are the most important therapeutic approaches for these females. Environmental factors, such as eating habits, play a significant role in both prevention and treatment, and the aim of diet therapy must be to improve metabolic, reproductive, and insulin resistance. These findings are consistent with those of Faghfoori et al. (2017). This can be achieved by using Pender's health promotion model to develop a low-calorie diet plan that will assist individuals in losing weight or maintaining a healthy weight. The aforementioned findings validated the present study hypothesis.

The findings of the present study were almost identical to those of a study conducted by Iqbal in 2023, who demonstrated that the mean scores of the females under study regarding dietary intake and nutritional behavior before and after dietary advice differed significantly (p-value<0.001). Over the course of the study, the cohort's overall mean score for nutritional behavior grew from 22.00±7.30 to 65.90±8.89. In other words, prior to and following dietary instruction, less than five percent, less than half, and more than two-thirds of the females in the study, respectively, exhibited healthy nutritional behavior.

Furthermore, Hajivandi et al. (2018) explained that when females with PCOS maintain a healthy weight and exercise self-regulation in their eating patterns, they see a notable decrease in problems. This is due to the fact that obesity and overweight play a significant role in the onset and consequences of PCOS.

Regarding self-regulation of eating behavior, the current study clarified that the mean scores of the females under study at the pre-, post-, and follow-up phases differed significantly (p-value<0.001) according to statistical significance. In favor of the follow-up phase, the overall mean score of the females' eating behavior self-regulation increased from 10.63±3.17 to 17.32±2.71 and 21.54±1.89 over the course of the study. The results of this study showed that

females' eating habits were successfully controlled when Pender's health promotion model was used to PCOS females with insulin resistance.

Accordingly, the current study concurred with Guo et al. (2022), who explained that the mean score of the females' self-regulation of eating behavior increased from 8.63±6.77 to 15.92±2.71 and 22.64±1.79 at the pre-intervention, three-month, and six-month points after the intervention; this was in favor of the follow-up phase. It demonstrated that one of the most crucial therapy modalities for IR linked to PCOS is nutritional behavior and attitude.

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The present investigation concluded by elucidating a statistically significant negative association (P≤ 0.001) between the females' total BMI during the pre-, post-, and follow-up phases and their overall score of dietary behavior. The findings of the current study were corroborated by Alzaben et al. (2024), who demonstrated a statistically significant negative association between the females' overall BMI scores before and after the intervention and their total score for nutritious behavior. The symptoms and problems of IR and PCOS reflect this, meaning that the better their eating habits, the lower their BMI and the closer they are to normal or optimum weight.

Conclusion:

According to the findings of the current study, females with IR linked to polycystic ovaries showed improved knowledge, nutritional behavior and dietary pattern, Pender's health promotion model components, and a significant decrease in BMI. The differences were highly statistically significant at the pre-, post-, and follow-up phases (p-value<0.001). Additionally, there was a statistically significant negative link (P≤ 0.001) between the females' total BMI scores before, during, and after the intervention and their total nutritional behavior score. Thus, the research goal was achieved and the research hypothesis was approved.

Recommendations

Based on research findings, it was recommended that:

- Use of a health promotion package based on Pender's model to teach high-risk females about the risk factors and ways to prevent IR linked to polycystic ovarian syndrome.
- Encourage females in their reproductive years to adopt nutritional preventive practices to maintain a healthy weight, prevent IR linked to polycystic ovarian syndrome, and prevent its sequelae by using Pender's health promotion model.
- Pender's health promotion model should serve as the foundation for ongoing, thorough, structured education programs for females with IR linked to PCOS.
- Examining how Pender's health promotion strategy affects additional gynecological conditions

Further researches:

- Undergraduate nursing students' knowledge and skills may be enhanced by incorporating health promotion concepts into their curriculum.

- The research re-applicability to other health care settings, including females of various ages.
- To be sure the results are more broadly applicable, repeat the study with a sizable representative probability sample.

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