EFFECT OF THERAPEUTIC EXERCISES ON WORKING MEMORY IN OBESE WOMEN WITH POLYCYSTIC OVARY SYNDROME - A PILOT STUDY

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ABSTRACT

BACKGROUND: Women with PCOS (Polycystic Ovary Syndrome) are thought to have hyperandrogenism which was hypothesized to be influencing the cognitive functions in various cognitive domains, mainly working memory. Physical exercise enhances prefrontal cortex activity and improves the working memory performance.

METHODOLOGY: Total of 18 right handed obese females having PCOS, pre diagnosed clinically were included for the study. Pretest values using Digit span forward and backward test was obtained from the clients, then integrated exercises were given and measured by the outcome measures Digit span forward and backward test. Results were tabulated using statistical analysis.

RESULT: The intervention group shows signification improvement than the control group with (p≤0.001).

CONCLUSION: This study concluded that working memory functions are affected in obese women having PCOS which leads to adverse effect on quality of life. Thus incorporating physical activity will lead to improved mental health in turn resulting in improved working memory and quality of life.

KEY WORDS: working memory, mental health, physical activity, quality of life (QOL), Brain gym, Polycystic ovary syndrome PCOS.

I. INTRODUCTION

In the scientific literature, female sex hormones and the menstrual cycle have linked to cognitive performance. Polycystic ovary syndrome (PCOS) was first identified by Stein and leventhal in 1935 so that it is also called as Stein leventhal syndrome. Polycystic ovarian syndrome (PCOS) is a reproductive – metabolic disorder primarily characterized by hyperandrogenism and chronic anovulation disrupts HPO axis¹. The WHO estimates that PCOS Effects as many as 116 million women around the globe. Most studies in India report prevalence of PCOS as 9.13% to 36%². Polycystic Ovary Syndrome (PCOS) is a hormonal disorder that affects between 5-10% women of reproductive age and remains the most enigmatic reproductive disorders by hyperandrogenism ovulatory dysfunction and polycystic ovaries. Scchitano et al., reported that women with PCOS have higher risk of
cardiovascular diseases, which related to metabolic dysfunction, peculiar hormonal pattern, hyper androgenism, insulin resistance, dyslipidemia and inflammatory state.

Working memory processes includes temporal storage and manipulation of information and it needs multiple processes of cognition such as language, perceptual speed, verbal and visual memory, and planning (Soleman RS et al). Working memory is an early process of brain function that is crucial for the learning process. It provides temporary storage of information necessary for a more complex learning activity (Baddeley, 2012). In 1974, Baddeley & Hitch proposed a model of working memory that becomes an alternative to various models of memory storage. Cognitive performance is compromised, in women with PCOS. There have been few investigations of the effect of PCOS on the brain.

Figure 1. Baddeley Working Memory Model (2012)

Several Studies described poorer performance on tests of verbal fluency, verbal memory and visuospatial working memory in PCOS. Some early evidence suggests that metabolic risk states may have an influence on brain structure. According to the Rotterdam criteria patients are diagnosed with PCOS when two of the three following symptoms are present namely: Oligo ovulation, hyperandrogenism, polycystic ovaries on Ultrasound.

Physical activity is prescribed as a component of primary management for polycystic ovarian syndrome. Aerobic exercise will have an effect on PCOS include reduce weight, reduce depression and anxiety, improve frequency of menstrual cycle and ovulation. Resistance training will help to reduce insulin resistance, increasing metabolic rate, improving body composition.

The best measurement of working memory performance involves a combination of different tests to produce a score with high reliability and validity (Kane et al., 2005). Digit span forward and backward tests are frequently used to assess verbal and visuo-spatial short term memory.

Forward span of this tasks, primarily evaluate the functioning of the working memory material-specific systems such as phonological loop, and the visuo- spatial memory. The backward span of this task, the sequence of items have to be reported in reverse order, are believed primarily tax central executive functions.
Background
Altered insulin sensitivity is associated with changes in neurogenesis. TBSS (tract based spatial statistics) showed areas of decreased AD (axial diffusity) in PCOS throughout white matter.

Reference: Maneesh Udiawar, Rok Berlot, Michael o Sullivan and Alled Rees (2014); Reduced cognitive performance and altered white matter microstructure in insulin resistance women with PCOS; Endocrine Abstracts

These findings suggest that the high frequency sensitivity and working memory is affected in subjects with PCOS compared to the normal group. The study highlights the importance of early identification of hearing loss in PCOS group and the importance of auditory working memory screening in women with PCOS.


Need of the study
• PCOS being the leading cause of the women’s health risk, needs to be addressed at priority. Recent studies have shown that there is link of PCOS with working memory.
• A recent study states that origin of PCOS may not be in the ovaries but in the brain
• Level of working memory, directly affects the quality of life.
• Once the lifestyle changes are made by PCOS women through increase in physical activity, there is need to find out, up to what extent it effects Working memory.

Aim of the study:
To find out the working memory in poly cystic ovarian syndrome (PCOS) women.

Objective of the study:
• To determine the working memory in PCOS women.
• To find out the link between working memory and physical activity in PCOS women.

II. MATERIALS AND METHODS:
The study conducted in clinical setup in Chennai. The study design is experimental and comparative study. 26 samples used in this study the samples selected by Rotterdam criteria in that 8 dropouts due to lack of cooperation and interest. Then 16 active participants were included with the informed consent. Study duration is 12 weeks. The inclusion and exclusion criteria for the study as follow:

Inclusion criteria
• BMI>30 Class 1 (low-risk) obesity, if BMI is 30.0 to 34.9.
• Max heart rate 220-age
• Females (both married and unmarried)
• Age 18 to 35
• PCOS selection based on Rotterdam criteria
• Samples include all phenotypes of Obese PCOS women
• Right handed females
• MOCA 19 to 25/30 mild cognitive impairment
• Clinically diagnosed cases of obese PCOS women.
• Presence of cognitive complaints
Exclusion criteria

- Diabetes
- Hypertension
- Other causes of irregular or absent menstruation and hirsutism such as hypothyroidism congenital adrenal hyperplasia, cushing syndrome hyperprolactinemia, androgen secreting neoplasm
- Neurological conditions like dementia, parkinsonism
- Recent injury or surgeries
- Pregnancy
- Uncooperative patients

Materials required:

- Inch tapes
- Weighing scale

Outcome measures:

15 DIGIT SPAN FORWARD AND BACKWARD TEST – Working memory

All the participants were informed about the purpose of the study before start the intervention. Written informed consent regarding the study was obtained from the students. Procedures was explained to the participants prior to the study. Toatal 16 participants participated in the study. Participants were randomly allocated into two groups. Group A (control group) and Group B (interventional group) within 8 participants in each group. Both groups are advised to take less calories and some diet restriction should be provided. Participants in Group A participants are advised to do aerobic, resistance and brain gym exercises while in Group B participants were advised to follow lifestyle modification. Before and after, 12 week of exercises programmes the pre and post test should be carried out for data analysis

Group A (intervention group) was given aerobic exercises, resistance training and brain gym exercises for 60 mins /day for 6 days per week for 12 weeks. (Note: the aerobic exercises and resistance training performed in alternative days respectively). The intensity of the exercises were increased on the weekly basis depending on the capacity of the individuals. The exercises prescribed for group A are:

- Warm up - 5 minutes
- Breathing exercises - 10 minutes
- Surya Namaskar - 5 minutes
- Brain gym exercises - 15 minutes
- Aerobic/ resistance exercises - 20 minutes
- Cool down - 5 minutes

Group B (control group) was given life style modification . The lifestyle modification included mild exercises and diet counselling.

III. DATA ANALYSIS:

Data was analysed by SPSS statistics software version 25. The values of pretest and post test of digit span forward and backward test are listed in the tables below. Table 1 and 2 are comparison of pretest and post test of digit span forward in both the groups. Table 3 shows the significant improvement in both the groups. Table 4 and 5 compares the pretest and post test of digit span backward test in both groups. Table 6 shows the significant improvement in intervention group than control group.
TABLE 1 DIGIT SPAN FORWARD

<table>
<thead>
<tr>
<th>t-Test Result for Datasets:</th>
<th>T</th>
<th>Percentage increase comparison between Control and Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 1 Range = Test 2!$I$3:$I$11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set 2 Range = Test 2!$D$3:$D$11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std Dev.</th>
<th>Std Err</th>
<th>Lower 95% CL</th>
<th>Upper 95% CL</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Increase - E2</td>
<td>26.786</td>
<td>14.130</td>
<td>4.996</td>
<td>14.973</td>
<td>38.599</td>
<td>8</td>
</tr>
<tr>
<td>% Increase - C2</td>
<td>22.083</td>
<td>12.043</td>
<td>4.258</td>
<td>12.015</td>
<td>32.152</td>
<td>8</td>
</tr>
</tbody>
</table>

1-tailed t-Test (% Increase - E2 > % Increase - C2)

<table>
<thead>
<tr>
<th>Ho. Diff</th>
<th>Mean Diff.</th>
<th>SE Diff.</th>
<th>T</th>
<th>DF</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>4.702</td>
<td>6.564</td>
<td>0.716</td>
<td>14.000</td>
<td>0.243</td>
</tr>
</tbody>
</table>

Not Significant 'p' > 0.05

Inference:

Post test mean percentage increase in Experiment is NOT SIGNIFICANTLY DIFFERENT FROM mean percentage increase in Control

Effects in Control and Experiment almost equal

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std Dev.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>12.043</td>
</tr>
</tbody>
</table>

Variability is very high in both Control & Experiment

TABLE 2
Table 2 DIGIT SPAN BACKWARD

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std Dev.</th>
<th>Std Err</th>
<th>Lower 95% CL</th>
<th>Upper 95% CL</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Increase - E3</td>
<td>54.16</td>
<td>7</td>
<td>9.183</td>
<td>32.45</td>
<td>75.88</td>
<td>8</td>
</tr>
<tr>
<td>% Increase - C3</td>
<td>15.00</td>
<td>3</td>
<td>6.478</td>
<td>-</td>
<td>30.31</td>
<td>8</td>
</tr>
</tbody>
</table>

1-tailed t-Test (% Increase - E3 > % Increase - C3)

<table>
<thead>
<tr>
<th>Ho. Diff</th>
<th>Mean Diff.</th>
<th>SE Diff.</th>
<th>T</th>
<th>DF</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>39.16</td>
<td>11.23</td>
<td>3.485</td>
<td>14.00</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Significant: 'p' < 0.01

Inference:
Post test mean percentage increase in Experiment is significantly different from mean percentage increase in Control

<table>
<thead>
<tr>
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<th>Std Dev.</th>
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<tbody>
<tr>
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</tr>
<tr>
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<td>15.00</td>
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</tr>
</tbody>
</table>

EXPERIMENT IS EFFECTIVE
RESULT:
The result shows that both the control group and experimental group are having significant effect in improving working memory in PCOS women (P ≤ 0.001). The mean value shows that the intervention group shows more effective significant difference than the control group in improving the working memory in obese PCOS women.

IV. DISCUSSION:
The aim of the present study was to evaluate the effectiveness of working memory in PCOS women and compare it between the control and experimental group. The result of present study confirmed that the physical activity exercises (which include aerobics, resistance training, brain gym) had very significant improvement in the working memory in obese PCOS women compared to life style modification. In this study there is significant improvement in intervention group following 12 weeks of exercise training. Mohammed Reza Kordi et al. (2011) stated that aerobic exercises program showed improvement in clinical symptoms, physical fitness and reduced fasting insulin and serum androstenedione in young PCOS women. Ida almenning (2014) stated that, progressive resistance training effectively improved hyperandrogenism reproductive function and body composition in women with PCOS. Paraskevi preiculous (2018) stated that both HIIT and ST had beneficial effect on body composition in PCOS women. Jean Blaydes (2001) a Neurokinesiologist, through her research found that not only the memory retrieved better when the information is learned through the movement, but that physical activity increases a certain proteins to strengthen the memory retention. As our study reveals, the research study also confesses that brain gym is a program of exercises that focuses on performance of specific physiological activities that activate the brain, thereby enhancing cognitive performance and making it more receptive to learning. Brain gym exercises are designed to develop the brain neural pathway the way the nature does through movement. Although Polycystic Ovarian Syndrome (PCOS) is more commonly associated with pregnancy complications or menstrual issues, it can go beyond these problems. Evidences suggest that women with PCOS (Polycystic Ovarian Syndrome) frequently struggle with mental disorders, including depression, a chief symptom of which is difficulty in concentration, working memory, verbal fluency, and manual dexterity.

According to Tina Hephzibah Sundararaj et al there is effect on working memory in women with PCOS. There is a “significant” psychological risk in women with PCOS, and that regular screening for cognitive function should be an integral part of any PCOS (Polycystic Ovarian Syndrome) treatment. Women having PCOS since long and with symptoms more prominent and low score on physical activity questionnaire performed less on working memory task. Women high on physical activity performed better on Digit span backward test. Women who performed low on digit span backward test had poor quality of life. Researches show that women with PCOS have performed less on working memory tasks.

V. CONCLUSION:
The study concludes that both life style modification and physical activity training are effective in improving working memory in PCOS women. When compare both the groups were compared the intervention group, who underwent physical activity I in the form of combined exercise protocol showed significant improvement in working memory tests than the control group who underwent only life style modification.
Limitation and Recommendation:

- Smaller sample size
- PCOS subjects were selected by the Rotterdam criteria, which embrace a less severe metabolic phenotype than other definitions of the syndrome
- The Rotterdam criteria also encompass a heterogeneous group, hence future studies should compare distinct PCOS phenotypes.
- More sensitive PCOSQ questionnaire can be used like PCOSQOL scale
- Other components of working memory can also be checked
- Both the handed individuals can also be included in the study

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